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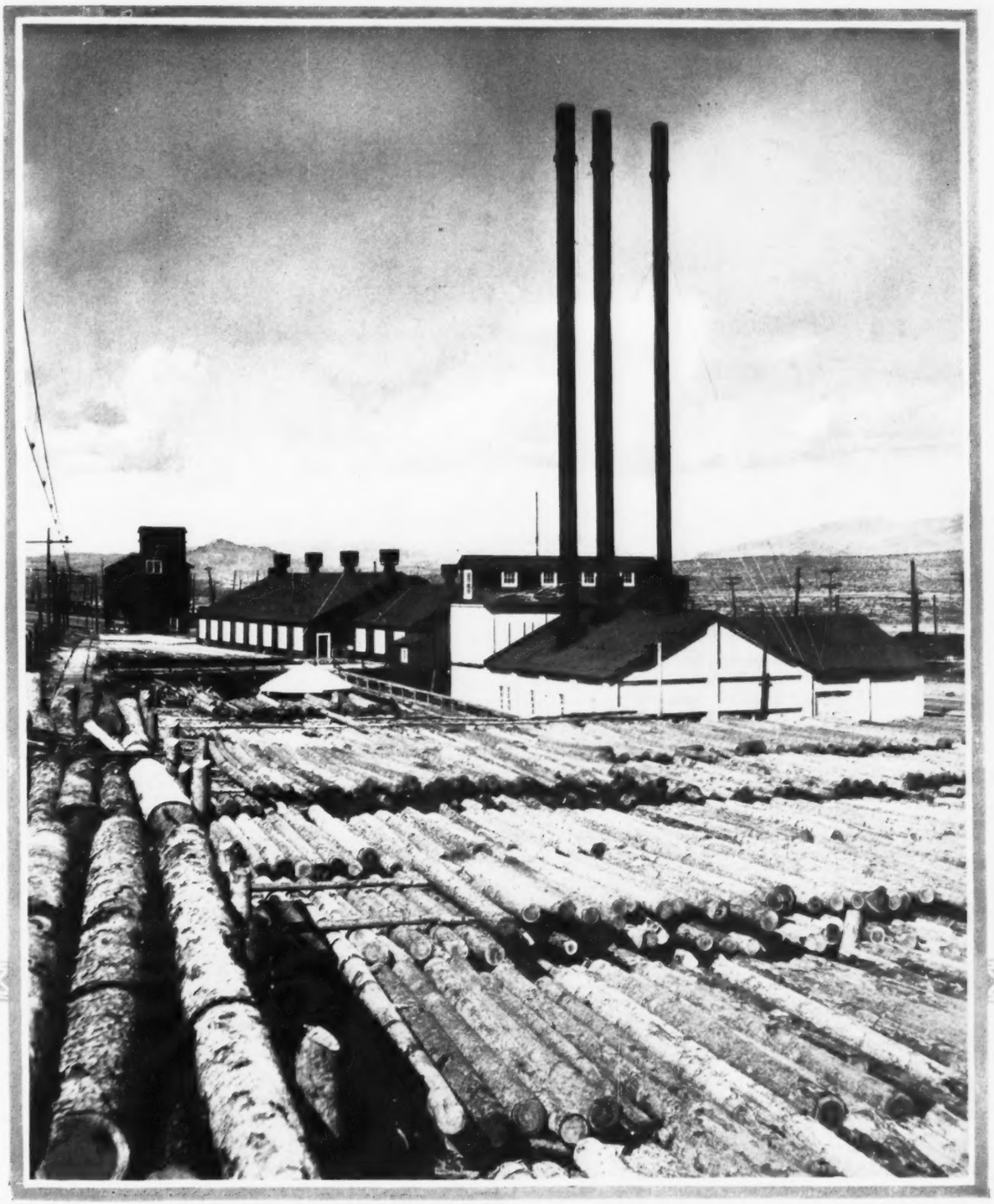
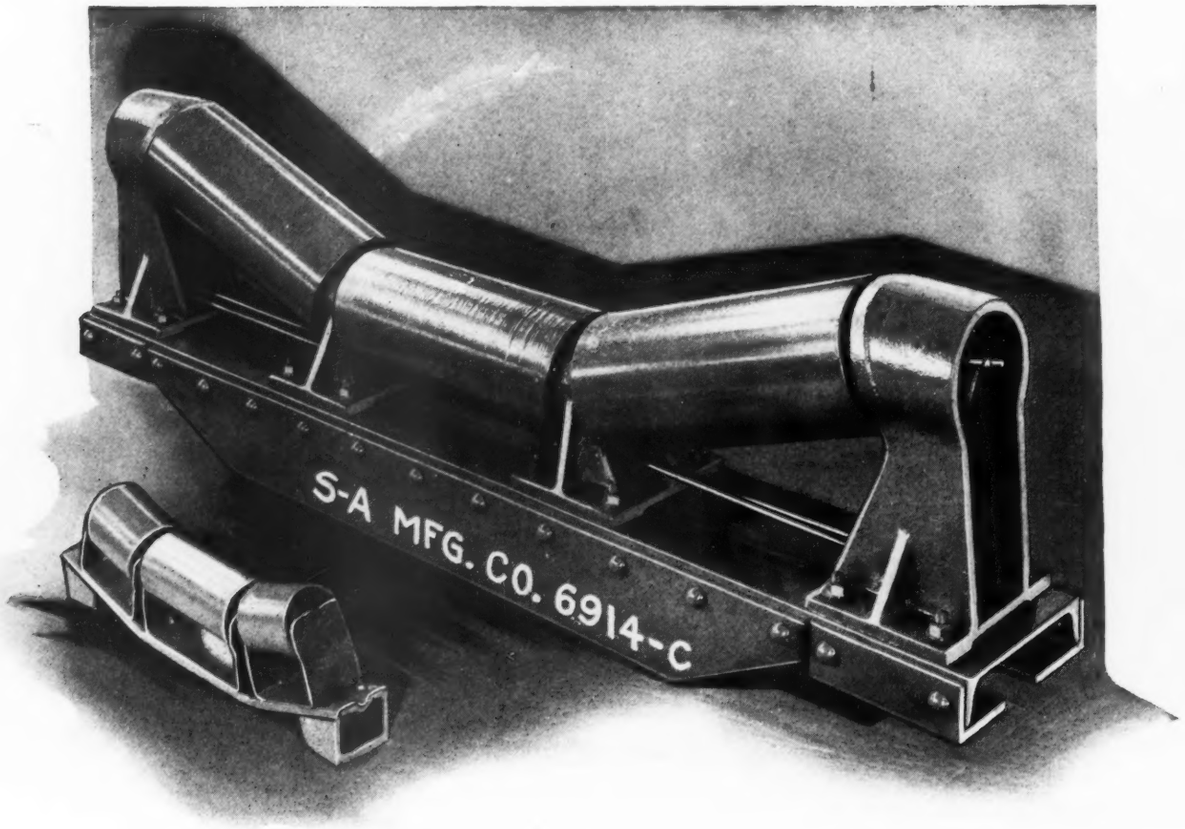


Automatic Steel Mine Timber Framing Plant at Butte, Montana

Geologic Criteria for Large-Scale Tin Prospecting in Bolivia, by F. R. Koeberlin

Tabling Tungsten Ores Without Water, by Walter X. Osborn

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ENGINEERING AND
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JOSIAH EDWARD SPURR, Editor

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## Funds for the Bureau of Mines

THE BUREAU OF MINES in Washington is passing through some interesting experiences. When it was transferred to the Department of Commerce from the Interior Department, at the suggestion of Mr. Hoover, it was argued, in effect, that it belonged there, since mining was a business and the products of the mines were important articles of commerce. This was admitted even by those who opposed the transfer on other grounds; and the advantage was seen that it would be possible to secure representation, if the Bureau were under the Department of Commerce, of the economic as well as the technical problems of the mining industries. This development is necessary if mining is to be properly reflected and assisted by the Bureau; the idea of mining as a science but not a business is plainly only half the picture.

The case of mining is analogous to agriculture, which is represented by a Department instead of a Bureau, and which includes a Bureau of Markets, devoted to the economic side of the farming industry. Within the Bureau of Mines, when it was in the Interior Department, the necessities of the war developed an economic organization, especially created by Congress and known as the War Minerals Investigation. The work of this organization was necessarily largely economic, and pertained to mining as one of the country's chief businesses; and there was developed a group of commodity experts, each of whom made an intensive study of the economic aspect of one (or more) mineral commodities. This was a popular and useful service, even after the war; but the termination of Congressional appropriations broke up the organization, and except for vestigial remnants thereof, the Bureau perforce reverted to what it was originally chartered by Congress to be—a technological bureau.

The system of a corps of commodity experts was that used by Mr. Hoover and Dr. Klein in building up the organization of the Bureau of Foreign and Domestic Commerce; and with the transfer of the Bureau of Mines, it was to be expected that something akin to the War Minerals Investigation system would be revived. It is not the fault of Secretary Hoover or of Director Turner that this is not being done; for the wherewithal therefor—the money—has not been obtainable from the Director of the Budget or by special appropriation from Congress. The Coolidge campaign for economy has nipped these expansion plans in the bud. One of the arguments which was used and was efficacious in securing the transfer of the Bureau to the Department of Commerce was that it would effect economy. It is hard to see on what grounds this claim was made; at any rate, it has not been made good. The Budget Director insists on economy in appropriations, with the result that the Bureau has really less money to carry on its former operations than it had when in the Interior Department.

There is only one possibility left—a deficiency appropriation, made direct by Congress, and not subject to the Director of the Budget. Such an attempt is being made by Senators and Congressmen who have the interests of mining at heart, in a bill (S. 5329) now before the Senate and introduced by Senator Oddie.

So far the committees which will have to consider the bill have not shown themselves enthusiastic, accusing the Bureau of Mines of invading the field of the Bureau of Foreign and Domestic Commerce, and censuring the growth of bureaucracy in general. But the interests of the American mining industries would certainly be furthered if the increased appropriation were granted. They specify $40,000 "for promoting mineral commerce." Besides this, further appropriations are asked for other activities of the Bureau: for mineral mining investigations, $25,000; for mine rescue work, $55,500; for investigating mine accidents, $35,000. The appropriation "for mineral mining investigations" it is proposed to expend, if obtained, in making an exhaustive study of geophysical methods as applied to the finding of ore and oil, this study to extend over five years. It is highly desirable that such investigations should be made by an independent organization like the Bureau of Mines, although it is likely that informative bulletins could be issued long before the end of the five-year period.

It is to be hoped that the Bureau may be allocated, by this special means, sufficient funds to enable it to make these needed extensions to its service.

## Silver Touches 60c.

NO HASTY CONCLUSION should be reached that the crisis in silver has been passed and that higher prices are to be expected just because the 60c. level has again been touched. At the same time, the recent climb is highly agreeable to the producers—even to those who were bearish a month or two ago. The reasons for the advance are of Oriental origin, both China and India being buyers. In China the annual settlements that are customarily made after New Year's (Feb. 2) apparently were effected as usual. Moreover it is probable that the increasing gravity of the political situation has induced bear covering. Neither of these conditions can be counted on to sustain buying; but the requirements of silver with which to pay soldiers may be a favorable factor for an indefinite period.

In India the normal demand for silver on private, as distinguished from government, account seems to be good, and there is no reason to expect an early change as long as the "up country" is reasonably prosperous.

Moreover, the entire world probably is getting back to normalcy after the psychological disturbance created by the issue of the report of the Indian Currency Commission. However, those who usually have guessed well on the course of the silver market are not inclined to be optimistic.

## War Minerals Relief

HEARINGS on another proposal to revive "War Minerals Relief Legislation" are being held by the House Committee on Mines and Mining. It has been about eight years since $8,000,000 was appropriated for this purpose, and claimants spent several years in setting up their cases. All cases wherein claims could be substantiated were equitably adjusted. Others which could not were dismissed, and the unexpended balance reverted to the U. S. Treasury.

A renewal of this legislation at this late date does not seem to be justified. Those whose claims were turned down certainly cannot present any stronger case than they did at first. Facts were facts at that time, and a lapse of time has not increased their so-called "war expenditures," nor contributed one iota to enlarging or substantiating their losses, unless a failing memory might eliminate any damaging evidence, or by the repetition of a few points of vantage the evidence may attain mountain height.

It seems that "war mineral claims" and "income tax settlements" cannot be considered closed until the government assumes the entire burden. Lawyers, attorneys, and so-called "tax hounds" are largely responsible for lack of "terminal facilities" for claims against the government. "Let the dead past bury its dead" and the war minerals relief be a closed incident following a great war.

## Another Decision on the Carson Reverberatory Patents

THE RECENT DECISION of Judge Bourquin in favor of the Anaconda Copper Mining Co. in the Carson reverberatory patent infringement case reverses the apparent momentum acquired by Carson and his attorneys in their successful litigation against the American Smelting & Refining Co. The status of the cases brought to trial so far is represented by the Afterthought, which was a nominal victory for Carson; the Tacoma, which was adverse to Carson but which was subsequently reversed by the Federal Court of Appeals and which was refused a rehearing and also presentation to the Supreme Court, and this last decision, which was adverse to Carson and his backers. It is worthy of note that the Anaconda case was more thoroughly defended upon the basis of metallurgical principles than any of the others. It has been announced that the Anaconda decision will be appealed and will be reopened before the same court of appeals that reversed the decision in the Tacoma smelter case.

However interesting the legal intricacies of these cases may be, it is greatly to be regretted that copper-smelting companies should be confronted with extensive litigation having to do with their methods of smelting. The onus of this apparently rests with Patent Office procedure, which was responsible in part at least for delaying the issuance of the Carson patents. The existence of the Siemens patent, which first presented the side-feeding principle years ago, would appear to have invalidated this feature of the Carson patents, but apart from its recognition as such in the Tacoma case, it was not recognized by the other courts, nor did the Patent Office give it the recognition which it probably deserved.

One of the features in the defence made by Anaconda was the experimental try-out of Siemens' ideas. Another feature was testing, upon a working scale, of the relative merits of side and center feeding. Still another point was the introduction of testimony to show that side-feeding furnaces had been employed in copper smelting at Dollar Bay, Mich., prior to the patent applications made by Carson, but some doubt was expressed by the court as to whether these operations anticipated his patents. The decision in favor of the defendants was based largely on the fact that disclosures in the Siemens' patents invalidated those of Carson; it was admitted that the Anaconda company had "in some kind and extent" infringed Carson's patents.

Patent adjudication should be brought about by less clumsy and less time-consuming procedure than is exemplified by the present litigation, which now looks as if it would be indefinitely prolonged until it reaches the United States Supreme Court.

## Delivery Charges on Refined Copper

A REVISION OF FREIGHT RATES on the Eastern railroads went into effect at the end of January, whereby delivery charges on copper shipped from Eastern seaboard refineries to so-called Middle Western points were increased. Where the rate had been 25c. per 100 lb. to Detroit, for example, it is now 31c.; Pittsburgh was increased from 25 to 27c., Rome from 22½ to 25c., Chicago from 32 to 40c., and similarly to other points. In some instances, present rates are slightly less than before, as, for instance, from Baltimore to Connecticut points. These changes have made it advisable to recalculate the deduction to be made from the delivered price of copper to determine the cash f.o.b. refinery price quoted in the *E.&M.J.* Market Report.

In view of the increased rates to Middle Western points of consumption, and to the increased tonnages of copper now shipped from Eastern refineries to that territory, it seems best to consider the markets separately. Copper is sold at one price to practically all Eastern consumers; and at another price, somewhat higher, when delivered to Middle Western consumers, to whom the freight rate is higher; so that the f.o.b. cash refinery price may be estimated with comparative accuracy by deducting the average delivery and interest charges in each area from the actual price received delivered at consumers' works.

Through the co-operation of all producers, we have been given a statement of shipments from each refinery to each consuming point, covering a year's interval, to which we have applied the new local freight rates, thus obtaining a weighted average of delivery charges on all copper sold in each of the two principal selling districts above mentioned. To the actual freight charges is added a small allowance for loss of interest on the value of the copper in transit, figured at the rate of 6

per cent. The final result shows that a deduction of 22½c. per 100 lb. is proper on Eastern business, and 32½c. on Middle Western business. These deductions from delivered prices are therefore now being made, in order to determine the f.o.b. cash refinery price that the seller actually receives for his product at the point of production. No essential change in the refinery price of copper as quoted by the *E.&M.J.* will result, the deduction now being slightly less on Eastern business, and somewhat more on Middle Western business, than the old deduction of a flat 25c. for all delivery charges, established six years ago.

On copper shipped into New England over the New Haven railroad some sellers are enabled to take advantage of so-called "refining-in-transit" or "milling-in-transit" freight rates. That is, whereas the freight rate from the smelter to the Eastern seaboard refinery might be $17 per ton, and the local rate from the refinery to the Connecticut consumer might be $5 per ton, a through rate from smelter to Connecticut via the refinery (or "refining-in-transit" rate) of $18 might be quoted. This enables sellers, if they wish, to sell Connecticut consumers at a price somewhat less than would be quoted to other consumers to whom the local freight rate is little or no higher. Delivery charges in such cases are a matter of bookkeeping, and it may be argued either that, of the through rate, $13 shall apply between smelter and refinery and $5 between refinery and consumer, or that $17 of the through rate applies between smelter and refinery and only $1 between refinery and consumer. In view of this, and also of the fact that all sellers cannot take advantage of it, the local freight rates only are considered in making the deduction for delivery charges.

## Prospecting by Radio

RADIO'S WONDERS are common knowledge. So thoroughly sold is the public on the possibilities of applied science as a result, that it is ready to believe almost anything that seems mysterious, if the claims for it are asserted loudly enough. This susceptibility leads the public into error and makes it easy for the pseudo-scientific to be palmed off on it as truly scientific. Likewise, when extravagant claims are made for some recognized prospecting device or method the public readily accepts them on their face. The phraseology of these claims is apt to be ambiguous, doubtless offering legal loopholes. Of the two meanings, though, the public may be trusted to pick the most fantastic.

For instance, publicity matter recently issued by a company that styles itself the Argus Research Corporation can hardly be called conservative. Over his own signature its president, D. G. Chilson, states "Argus Research Corporation has a tremendous advantage in the use of a very quick and direct method of locating hidden ore through my patented radio process. We should easily find many rich orebodies by this method."

Mr. Chilson's device is better known than any remarkable success that has been had in using it. For no geophysical method can remarkable success thus far be claimed. Success means finding ore, and discovery cannot be demonstrated until the ore has been actually proved by digging or by drilling. Success in such prospecting is not attained simply with the mapping and recording of results obtained with instruments. What warrant is there for the statement, then, that many rich orebodies should be found by the "patented radio process"?

In a noteworthy article in the issue of Jan. 9, 1926, Dr. C. A. Heiland said, in concluding, "Geophysical surveying methods are as yet only at the beginning of their development. The results so far obtained, however, encourage the hope that when carried to greater perfection, and used to supplement each other, they will eventually constitute a more and more indispensable part of the equipment of the mining engineer and the practical geologist." This is something that is generally recognized in the mining profession.

What if the ore isn't there? "Ore is where ore is," says Cousin Jack, "and where ore ain't, there be I."

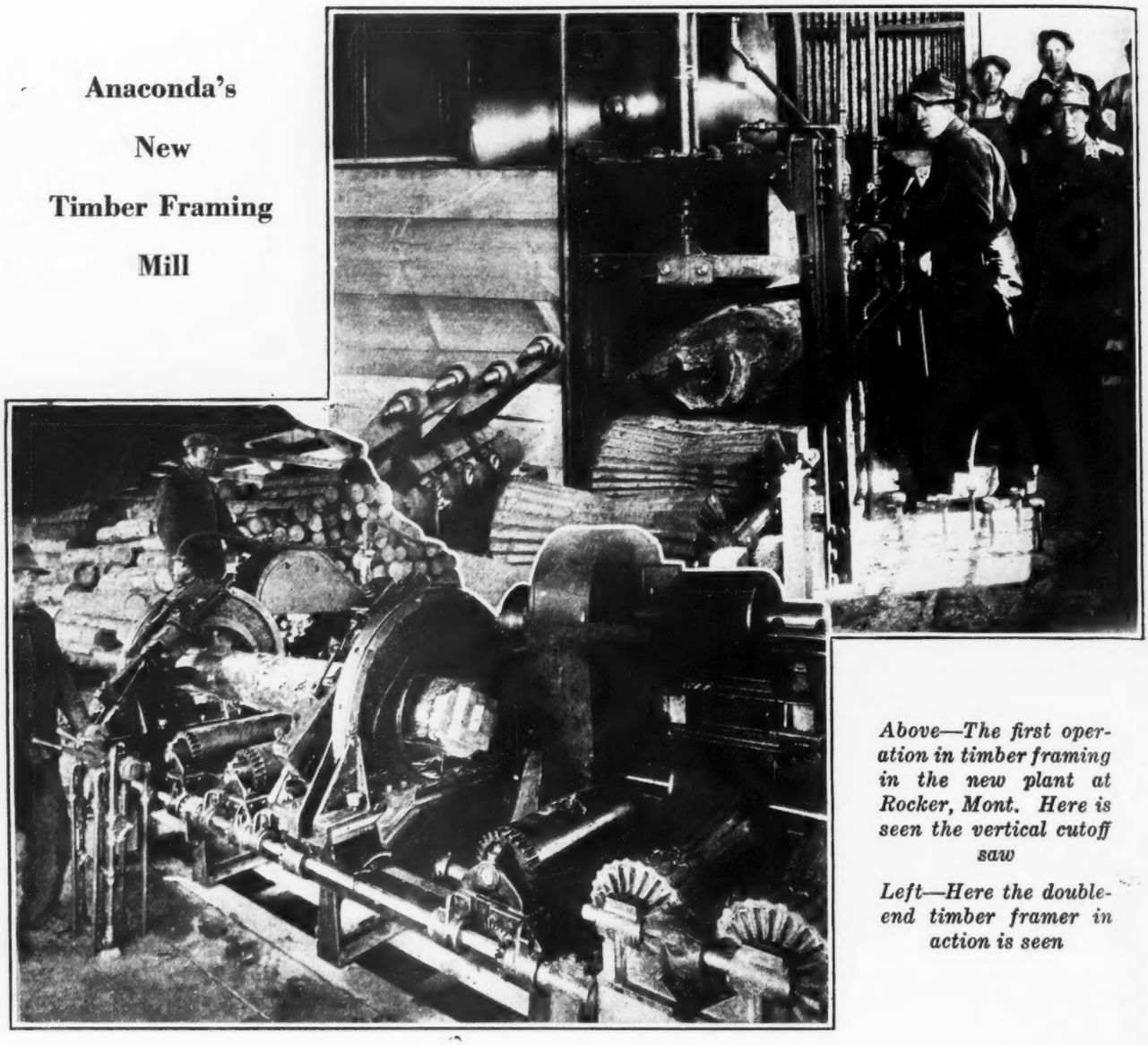
## Dictated by Common Sense

INFORMATION FROM RELIABLE SOURCES is to the effect that the American Smelting & Refining Co. will immediately curtail lead production from its own mines by about 15 per cent. The motive is obvious. The world during 1926 consumed more lead by about 6 per cent than ever before. The rate of production was increased to supply the metal. During recent months, however, there has been some slacking in demand without a corresponding decline in production. The old, old story again! Stocks of metal above ground have increased, not to an alarming extent, but sufficiently to favor the buyer; and prices in both foreign and domestic markets have declined. It seems likely that consuming demand will continue in somewhat smaller volume for the next few months. Accordingly, the logical measure to maintain or to increase the current price level is to restrict output. On its own initiative the Smelting company has taken this step, with respect to the mines that it controls. The company, of course, mines only a small proportion of the ore that it smelts, and the net reduction in output will amount probably to less than 1,000 tons per month.

The significance of the step lies in the example that it sets. No company is better able financially to weather a period of high production and low prices, and wait until some of the weaker producers are forced to shut down their mines to correct the situation. Instead, it is taking the lead in doing the common-sense thing. It is altogether likely that if enough others will take similar action, all will ultimately find themselves gainers. For well-known reasons no agreement to curtail can be entered into; that would entail what in this country is the grievous crime of "conspiracy to restrain trade." But there is nothing to prevent any individual company from cutting its own production. The trouble—not unnaturally—is that no one feels like bearing the brunt of curtailment to bolster up a market for the benefit of others who go merrily ahead with production. In this instance the Smelting company has taken the lead; others ought to follow.

All of the foregoing applies—several times more emphatically—to certain other metals, including copper. It is economically inadvisable for companies steadily to deplete their ore reserves (that some day will be exhausted) without giving shareholders an adequate return.

# Anaconda's New Timber Framing Mill



*Above—The first operation in timber framing in the new plant at Rocker, Mont. Here is seen the vertical cutoff saw*

*Left—Here the double-end timber framer in action is seen*

THE new mine-timber framing plant erected by the Anaconda Copper Mining Co. at Rocker, Mont., to replace the one destroyed by fire on Dec. 15, 1925, has been completed and is now in full operation. It is one of the largest of its kind in the world. Its capacity is 55,000 pieces of framed timber per month.

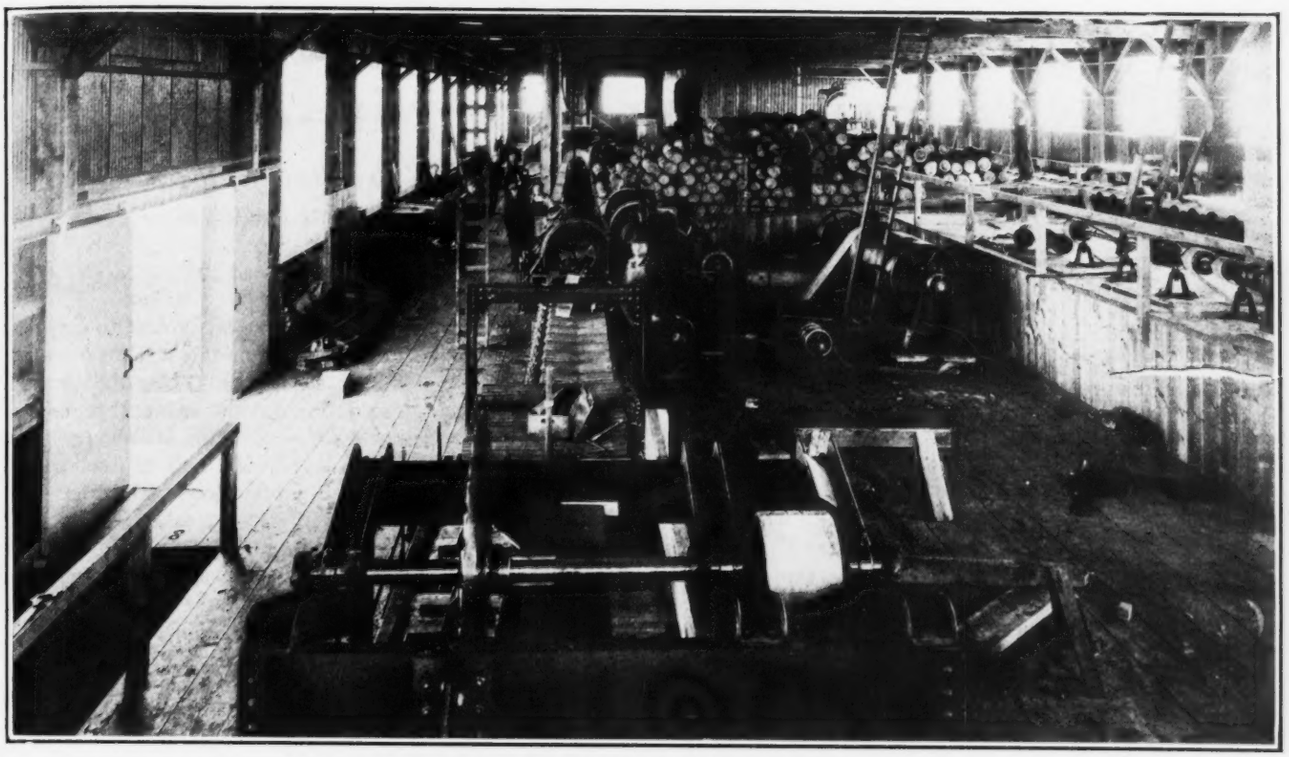
The main building is of timber and is 186 ft. long and 56 ft. wide. It is covered with corrugated iron on the sides and roof. The power house, which includes the boiler room and fuel bin, is of concrete, with a steel-truss roof covered with asbestos-covered corrugated iron. All of the machinery equipment is the latest and best the market has to offer. The principal machines include vertical cut-off saws, Greenlee double-end timber framers, and Greenlee slabbing saws.

In western Montana where the Anaconda company has large timber holdings the timber used is obtained. The logs when shipped to the plant are 16 ft. in length and vary from 6 to 17 in. in diameter. They are jack pine, spruce, fir, or tamarack. Logs used for timber framing are those not suitable for saw logs.

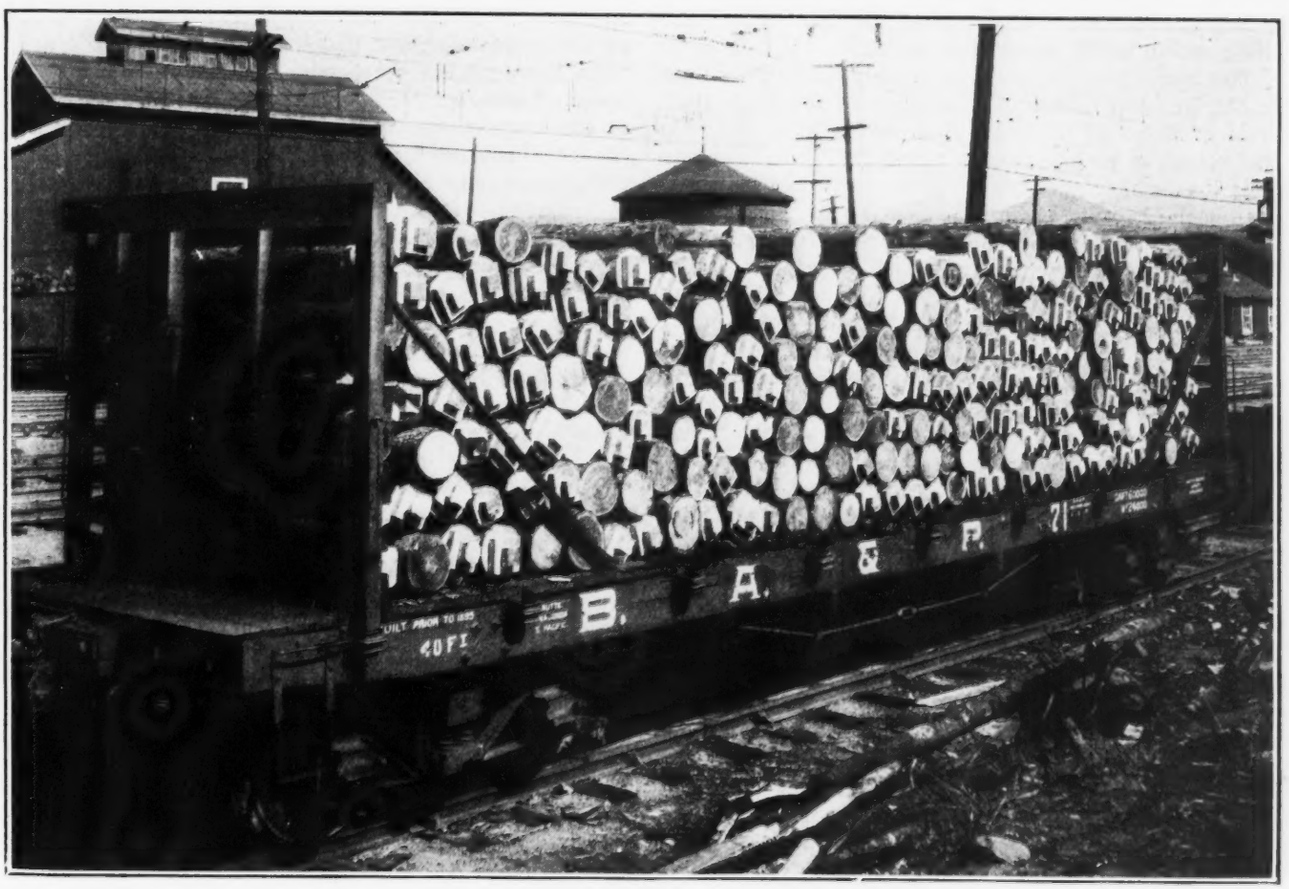
The standard sized frame used by the Anaconda company in its mines is a set 5 x 5 ft. centers, 7 ft. in length. A set is composed of four posts, each post having from 5 to 7 ft. clearance; two caps each measuring 5 ft. 4 in.; and two girts measuring 5 ft.

After the logs are received in the plant the manner of handling them is simple. They come in from the cars on a set of rolls, and pass through the cut-off saws to the transfer platform. From there they are rolled down an inclined platform to another set of rolls. These rolls carry them through the framers and slabbing saws. From there the cut pieces roll onto a loader, which loads them onto the cars for shipping to the Butte mines.

Steam power is used for operating the machinery. The boilers are fired by the waste wood. In this manner all the material sent into the plant is consumed either in the making of mine-timber frames or as fuel. The plant was erected at a cost approximating $200,000. It is equipped for the sole purpose of framing timbers used in the company's mines in Butte.



*The interior of the mill, with the slabbing saw in the foreground*




*First load of framed timber to go out of the new mill. From the company's own holdings, the timber, after being framed, goes on Anaconda's own cars and railroad to its own mines*

# Geologic Criteria for Large-Scale Tin Prospecting in Bolivia

*A New Phase of Seeking Minerals Approaches, Combining the Experience of the Geologist and Geophysicist—Zonal Theory of Deposits an Important Factor*

By F. R. Koeberlin
Consulting Geologist, Casilla 2200, Santiago, Chile

IN THE PAST few years the note of alarm has often been sounded over the approaching exhaustion of our ore reserves. Dr. H. Foster Bain, in the October, 1926, number of *Mining and Metallurgy*, says, "Exhaustion of the known reserves workable at present costs and yields may well be quick and disastrous." He immediately reassures us, however, and adds that the supply of metals will be forthcoming if the world wants them badly enough to pay for them; that it is a question of technology and price. Which of these two factors affecting future consumption will advance more rapidly? The world at large would like to see technology win the race. It probably will.

Technology, however, up to a few years ago, has not been of much assistance in finding ore, but the recent widespread interest taken in the application of geophysical methods to the problems of prospecting reminds one of similar flurries of enthusiasm in the beginnings of the cyanide process, the flotation process, the low-grade porphyry coppers, and so on. The mining community suddenly woke up to the fact that something worth while was taking place.

The subject has of late been widely commented upon in the technical press. E. DeGolyer in the May, 1926, issue of *Economic Geology*, goes so far as to say that the extension of our powers of observation made possible by the new geophysical instruments marks a new era in science. So far we have only the most elementary knowledge of how to use these tools, according to DeGolyer, but experience is accumulating rapidly. The geophysicist is a specialist of the highest order, but before he can begin his task he must be preceded by the geologist in the large-scale prospecting campaigns of the future. In the past, the prospector took a sample of a vein or a promising outcrop and gave it to the assayer to analyze. A shaft, drift, or crosscut may have been started on the basis of the information obtained. In the future, the geologist will pick out a section of promising territory from a region and give it to the geophysicist to test. The outcome of his dictum may be a vast exploration campaign. Both methods of procedure are somewhat alike. The last mentioned is more ambitious. It is a question of degree. The geophysicist has not yet attained the perfected routine of the assayer, and most of his methods will probably be greatly improved within the next few years, now that he is really putting them to the test of actual practice.

Two decades ago the genius of Jackling furnished the key for the low-grade porphyry coppers. As soon as it was proved that the key would work, the world was scoured for the low-grade, large-tonnage copper deposits. Most of them were found within ten years; not many since then. As a result the world is now glutted with copper. Will these new ore-finding methods produce similar effects? Are we going to have at least a temporary glut of all the metals? The question will probably be answered in this coming decade. Mother Earth has been doling out her mineral treasures in a measure as they were needed. She still has a large reserve for posterity, locked away and hidden under strong walls of later sediments, flows, and detritus. But if the geophysicist will give us the key to this treasure trove we would not be human if we did not rob it, even if we do suffer from indigestion afterward, like the small boys that got into mother's jam pantry. If the geophysicist can make the key, or in some way pick the lock, the geologist will be called upon to show him the pantry.

## Shortage of Tin an Incentive for Large-Scale Prospecting

Of the common metals tin is probably the one whose future reserves are in the most precarious position. No new fields of importance have been discovered for years. The known fields constitute fairly well demarcated metallogenic provinces, more clearly defined than those of the other metals. The reason for this rests on the fact that, zonally, tin is deposited nearer to its igneous source than the other common metals. Its range is limited by the short deposition radius from its igneous parent to restricted areas near the rims of outcropping batholiths, or where such masses approach relatively close to the surface. On the other hand, veins of silver, zinc, lead, and other metals may have their origin not only in near-surface but also in deeper-lying sources of igneous rock. Their surface distribution would consequently be more widespread, owing to the more comprehensive extent of the plutonic base, and the controlling factor of their location more difficult to determine.

To illustrate: If we imagine a forest in an undulating or a hilly country to be submerged under several hundred feet of water, the lowest growth, like scrub oak, will protrude only above water a short distance around the highest emerging or nearly emerging hills and ridges. Elms, being taller trees, would not be so closely controlled by the emergent ground. The tops would show even if the hillock on which they grew was under a considerable depth of water. The distribution of the emerging clumps is controlled by the invisible topography much more than in the case of the scrub oak. There would be islands of elm-tops irregularly scattered about. Pines and eucalyptus, still taller trees, will show an even more lawless distribution. A few solitary redwoods would be practically independent of any location control within the assumed premises.

Let the submerged topography represent the undulating roof of the plutonic mass, source of the mineralization; the scrub oaks the tin veins; elm, pine, and

eucalyptus the veins of zinc, lead, antimony, and so on, corresponding to the radii of their deposition zones from the parent igneous source. The tin lodes, being more closely tied in, are to that extent subject to closer control; the other metals progressively less so, as they ascend in the zonal column. The point I wish to make is that an approximate knowledge of the facts concerning the underlying batholithic roof conformation may be of value in large-scale prospecting, and, for the reasons given above, such information can be more readily obtained in the tin fields than in ore-bearing regions of the other metals.

### Zonal Conception Has Practical Application

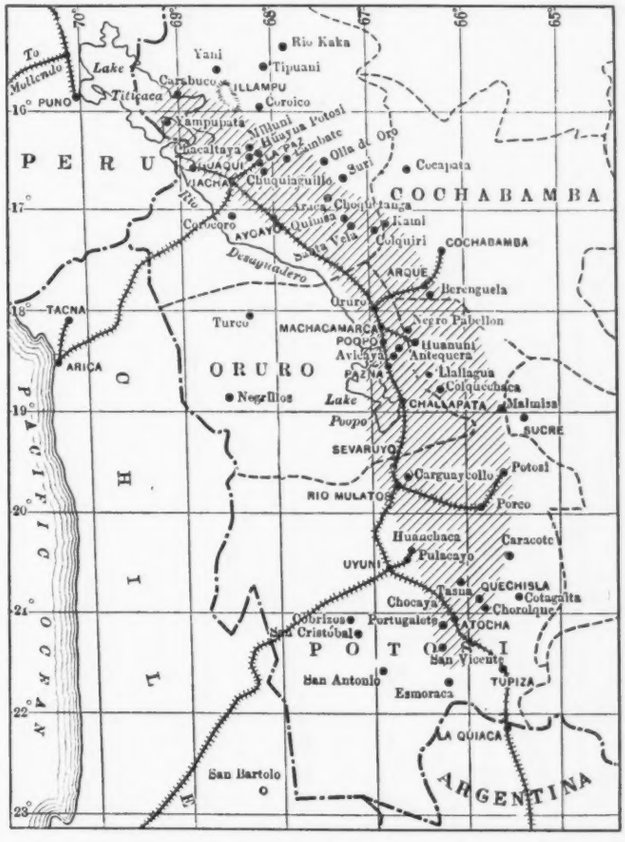
The conception of zonal deposition in veins of primary minerals is of great practical import. The principle was first clearly enunciated by Spurr[1] in 1907. It was elaborated upon by W. H. Emmons[2] in 1924 and in a recent paper[3] in 1926. This last paper is a valuable compilation of a mass of related data from mining districts in different parts of the world, accompanied by maps showing the distribution of the igneous rocks in many of these districts.

Emmons classifies the metalliferous lodes according to the relative areal exposures of the underlying batholithic roof in their respective districts. He brings out with respect to the known tin lodes of Europe and Australasia, that these occur near the rims of exposed batholiths or above the high points, "cupolas," of the concealed portions. In the central parts of the eroded batholiths no veins are found except in or near residual sedimentary islands or "roof pendants." Also, that they do not occur at the rims of very large batholithic exposures, significant of deep truncation by erosion. That is, recurring again to our former simile of the submerged topography, scrub oak does not seem to grow on the lower slopes of the mountain or in the foothills; and, likewise, the tin veins are not found deep down on the sides of the batholith. Radially outward from the tin lodes, veins of copper, zinc, and lead occur. Thus, a small clump of emerging elm-tops might signify a hillock not far below the surface of the lake; a larger clump or a fan-shaped spread of elms suggests, in turn, a ridge tending to emerge. A number of closely lying, let us say copper veins, or a group of them tending to spread or diverge, suggests the corresponding parallel in the case of the batholith. (In Bolivia, silver-zinc rather than copper seems to be next in line to tin.)

Naturally, such simplicity of arrangement is hardly to be hoped for, as there are too many modifying factors, which will be shown farther on. It is merely one of a mass of criteria that the geologist will have to weigh in his task of eliminating the unpromising territory in advance of the geophysicist. High points of concealed but near-surface batholiths have to the tin geologist somewhat of the significance that the anticlines and domes have to the oil geologist. The zonal conception as first outlined twenty years ago by Spurr brought out one of those vital bits of truth, the full importance of which the economic geologist is just now beginning to realize, and the last-cited paper of Emmons is the most important recent contribution on the subject, giving a clear and logical presentation of the working out of the law in a multitude of examples from actual mining districts. Bolivian tin districts were not cited by Emmons, nor are there any published maps of these which could have been used, but from personal knowledge of this tin field, I may say that it could furnish a number of strikingly corroborative examples.

### Trunk Veins on Master Fissures

Close students of Bolivian tin occurrences must have observed in many districts the difference in the character of the veins in the upper regions as compared with the lower levels. I do not refer to secondary changes




*Map showing main mining districts (after Miller and Singewald), with tin-bearing area (shaded portion) superimposed*

due to weathering, but to differences in constitutional character like that of strike and dip. In the first place, the veins are more numerous in the upper levels. With depth the number decreases as they unite on the dip. This, of course, is not an uncommon phenomenon in lode systems the world over, but the noteworthy point is that in the Bolivian deposits the surface veins are often entirely distinct as to strike and dip from the veins with which they connect in the lower levels. They do not seem to belong to the same system or systems. The veins of the deeper workings often do not outcrop, or, if they do, it is only for short distances as compared with their lower development.

In the quartz-porphyry district, Llallagua, for example, the main veins like San Fermin, San Jose, Reggis, and some others do not outcrop. A few relatively unimportant veins do outcrop and eventually join the cited veins, but they differ in strike and are more or less vertical, whereas the main veins dip on the aver-

[1] *Economic Geology* (1907), pp. 781-795.
[2] *Trans. A.I.M.E.*, Vol. 70, pp. 964-997.
[3] "Relations of Metalliferous Lode Systems to Igneous Intrusives," presented at the New York meeting, A.I.M.E. Feb., 1926.

age 70 deg. In this district the main veins fill prominent fault fissures varying in strike from N. 15 deg. E. to N. 70 deg. E. The surface veins, on the other hand, as well as innumerable small bleeding fissures, strike

*Fig. 1—Sketch showing section across vein system in quartz porphyry*

more or less uniformly N. 25 deg. E. These latter are probably contraction fissures, as they show no brecciation or relative displacement of the walls. They usually fringe out completely at a short distance from the feeding fault-vein.

At Chocaya, also in porphyry, the main tin veins outcrop for only a short distance as compared with their lower development. A number of small fissures, usually of steep dip and slightly different strike, do outcrop, and are gathered in by the main veins going downward. At Huanchaca, near the edge of the tin region, the famous Pulacayo silver vein in the lower levels is continuous over a stretch of more than three kilometers; yet on the surface only two or three branch veins outcrop over a short distance, and these have dips opposing that of the main vein below. At Colcha, a tin district lying entirely within the sedimentaries, the deeper workings have now demonstrated two fairly constant vein systems with definite strikes and dips. Some of these veins outcrop for relatively short distances on their fundamental strikes, but as a rule the upper levels show an anarchical disregard of the controlling factors below. The veins often take off between sedimentary strata into cross fissures, and from these into still others; so that a vein at the surface may present a strike almost at right angles to its ultimate course in depth. The same thing occurs, although less noticeably, in the Chacaltaya-KalaUyu-Victoria district near La Paz; in Antequera; in Negro Pabellon; in fact in nearly all except the most deeply eroded districts of Bolivia. In the sedimentaries and tuffs the surface veins may occur between strata or indifferently in fissures of small or large displacement. Minor fissures are naturally more common. In the porphyries the surface veins predominate in contraction fissures, or at least in fissures of small displacement.

Fig. 1 shows a generalized sketch of a section through a vein system in quartz porphyry. The letters *A* to *F* represent the main fault veins; the numbers 1 to 9 the fissure veins. The latter show little or no displacement and are probably contraction fissures. None of the fault veins shown in the section reach the surface, having been bled to death by the fissures before attaining this point. Veins 1, 2, and 3, which have been exposed by erosion, eventually connect up with the main fault veins *A*, *B*, and *F*. Veins 5, 6, and 8 have not been truncated by erosion. They are the final bleeding fissures of the fault veins *E*, *D*, and *C*. Since they do not reach the surface, they are blind veins, as in fact are all except the discovery veins of the district, 1, 2, and 3. With depth the fault veins pick up the fissures and also unite among themselves. In the system shown in the sketch, it is probable that vein *A* will ultimately gather in all of the others.

A generalized sketch of a section across a vein system in shales and sandstones is shown in Fig. 2. *A*, *B*, *C*, and *D* are fault veins, and 1, 2, 3, 4, and 5 are upper branch veins lying between strata or filling minor fissures. The upper veins are inconstant and discontinuous. The lower fault veins have been developed for considerable distances on the strike in the lower levels, but lose themselves in the upper regions. In the figure only vein *D* survives to the surface on the original fault, although *A*, *B*, and *C* have imperfect mineral connections with the surface through the branches 1, 2, 3, and 4. The relations are similar to the porphyry example, but somewhat more complicated, as the disturbed sediments offer channels of escape from the main ore conduits not only in breaks but also along bedding planes. Post-mineral slipping on bedding planes is also common in some districts and obscures the relations.

## TRUNK VEINS ARE CONDUITS TO DEEP MAGMATIC RESERVOIRS

Cross-section patterns of most of the Bolivian tin-vein districts bear some resemblance to tree outlines, the upper branches uniting into lower branches and finally into trunks; hence the term "trunk veins." Vein width, however, does not increase proportionally with depth in the lower branches and trunk veins. The trunk veins are the main conduits to the deep magmatic reservoirs. It will perhaps never be possible to determine what was the pre-erosion depth of these reservoirs. Vogt[4] estimates a depth of between ten and twenty kilometers. This may be excessive for Bolivia, which is still a thermal region. However, on the basis of the thickness of overlying sedimentary strata traversed by veins, as well as quartz porphyries cut by fault veins which have already been developed one kilometer below the surface, I think that five kilometers might be safely accepted as a minimum.

Emmons[5], also, in cited examples and by maps of tin districts, shows the close relationship of the tin veins to the granular—that is to say, deep seated—igneous rocks. In Bolivia quartz porphyry has always been considered as the magmatic parent of the veins when these veins occur in this porphyry. I no longer hold this view, but consider the porphyry as the congealed pre-mineral crust of the granular plutonic mass from which the ore magma was segregated. Quantitative considerations, for one thing, favor the larger batholith of granite or granodiorite rather than the smaller quartz-porphyry stock as the primary source of the magmatic distillate. Furthermore, the porphyry is tra-

[4] *Economic Geology*, Vol. XXI, p. 473.
[5] "Relations of Metalliferous Lode Systems to Igneous Intrusives."

versed by ore-bearing veins, and it must have been cold enough to fracture to considerable depths or the veins could not exist as such.

### Bolivia's Tin Ore-Magma Reservoirs Not Yet Eroded

From the foregoing it is gathered that the real batholithic source of the ore-bearing solutions in the Bolivian tin deposits, with a few exceptions like Caracoles, is as yet concealed—"cryptobatholithic" to use Emmons' formidable term. The quartz-porphyry districts and the sedimentary districts are alike in this respect, the porphyries simply taking the place of an equivalent covering thickness of sediments. It follows that the outcrops of a system of veins in the sedimentaries or in the porphyries must lie at a considerable distance from the point of origin of the veins. I have shown that the upper region veins often occur in contraction fissures, in small displacement faults and between strata. That such openings could extend to depths of 5 kilometers and more is scarcely tenable. It may be argued that dikes often occupy small displacement fissures, but the analogy is very imperfect. Dikes have the rending force of enormous masses of the same material back of them. Veins, on the other hand, release a slowly accumulating magmatic differentiate (the accumulation in itself presupposes depth under a cover of solid rock) in such relatively small quantities that bursting or rending apart of large masses of sediments or congealed eruptives is out of the question. Great masses of vein material corresponding in size to flows, dikes, sills, or stocks are not known. Even if one imagined the tension in the small reservoir of mineral differentiate to be sufficient to rend miles of the overlying rock, such an escape of vein material would at once be followed by the still fluid batholithic magma as the pressure is released.

### Fractures Must Be Far-reaching to Tap Ore-Magma Reservoirs

The only escape for the trapped accumulation of ore magma is a fault. But to reach such a distance downward a fault must be of large displacement. Small faults would die out before they reached the necessary depths. These large displacement faults tap the reservoirs of accumulated magmatic "juice" in the high points of the batholith if by chance they cut them. It would seem to be a case of a sudden gush of ore magma rather than a slow infiltration of solutions. The fault is the conduit or trunk vein to the upper regions.

The deposition zone of tin and other metals will probably lie relatively close to the surface. As this is approached the fault or trunk vein subdivides into minor and again into still smaller fissures until it is finally bled to death, and it and a host of its branch veins may never reach the surface, but may form the so-called blind veins, or veins that *peter out going up*, so common in Bolivia. I do not mean to intimate that the trunk vein is richer or wider than its upper branches, or that it is even in commercial ore. It may lie zonally below the deposition range. What is the object then, it may be asked, of this long preamble about the trunk vein, if in the end its commercial prospects are no better than those of the upper branches? I hope, however, to be able to show that the recognition of a trunk vein has a real practical bearing.

It is usually considered good mining practice to prospect the extension of a known vein if the geological conditions seem favorable, even if it does not show on the surface. It has, however, not been suggested that it is advisable to prospect for the extension of a system of veins at distances of 10 or 20 miles or more. And yet this is not a chimera. Oil geologists have solved more difficult problems. The trunk vein is a trunk conduit. Under a set of favorable conditions it gave rise to a system of surface veins. However, the trunk vein continues on its course beyond this particular district, for, as has been shown, it must be a large displacement fault. Such faults do not die out within the usual limits of a mining district. Farther along the fault may again pass through a set of favorable conditions, such as a batholithic high point or a physically favorable rock for vein formation. This time, perhaps, a covering of detritus hides the surface manifestations, so that the system has thus far escaped discovery. Or it may be that this system never reaches the surface, i.e., blind veins. Had there been *only 100 meters less erosion* at Llallagua or at Pulacayo, it is probable that these bonanzas would still be awaiting the first stroke of a pick. Prospecting for the extension of a system is like prospecting for the extension of a vein. The work is more complicated, the results are more uncertain, and the rewards larger. It is again a question of degree.

### Criteria for Recognition of Trunk Veins

What are some of the criteria for recognition of a trunk vein? As in the case of a sedimentary horizon which can seldom be safely correlated on the basis of a single fossil, so with trunk veins the degree of probability increases with the number of criteria available and the internal agreement of these. The most useful single one is probably displacement; but to recognize this in itself often constitutes a problem, especially in igneous regions. However, in Bolivia a long range of vision is usually granted, and slight changes of color, of surface asperities, of vegetation, of topography, are eloquent to the practised eye.

The prevailing strike of a known system of veins over a suspected trunk vein is in itself no safe criterion and may put one on the wrong track entirely, for, as has been shown, the upper veins usually differ in strike

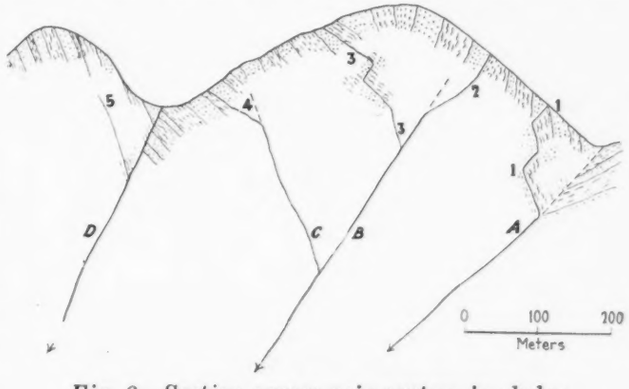



*Fig. 2—Section across vein system in shales and sandstones*

from the lower veins, and these in turn need not necessarily be the lowest branches of the trunk. The upper veins simply represent pre-existing cavities which were filled, like a sponge, from the trunk conduit when the reservoir was tapped.

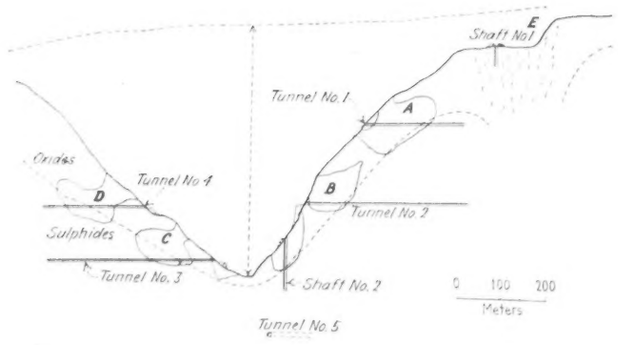



*Fig. 3—Longitudinal section of tin vein with orebodies localized near present-day surface*

On the other hand, neither is a very wide divergence in the strikes of the upper veins and the trunk veins to be looked for, except in some sedimentary districts. The trunk-vein fault probably but not necessarily involves a greater displacement than its tributaries. Necessarily, however, it must be the latest pre-mineral fracture in any given epoch of mineralization. It is not excluded that in a given district there may be more than one trunk vein. A number of fault veins, closely parallel as to strike and dip in the lower levels, would be suggestive of a fault zone in which the total displacement is distributed in a number of step faults. The individual steps might reach to the reservoir separately, or unite at greater depths. The point to be considered should be, is the individual or the aggregate displacement of the group sufficient to premise or indicate a trunk vein?

## Secondary Enrichment an Important Factor

Secondary enrichment of tin veins is a factor which in itself does not involve large-scale relationships like those of batholithic roof conformation and trunk veins, but in its untested possibilities it covers a field so large that it may well fall within the category expressed in the title of this article. It seems strange that a process so apparent in the field should for such a long time have lacked recognition, but it shows the strength of a preconceived notion; in this case, the insolubility of cassiterite. Observers have for a long time recognized the outstanding fact of enrichment, and have at times appealed to the wildest ideas and most fantastic agencies to account for these facts, such as mechanical downward migration in the vein of cassiterite grains. Having had the opportunity to study many Bolivian tin deposits, and especially some of the more important ones, over a term of years, I was impressed with the amount of geological evidence pointing to the solution of cassiterite in veins and its redeposition at lower levels. In an article in the *Engineering and Mining Journal-Press*, April 17, 1926, I cited some typical examples of enriched Bolivian veins and invited discussion of the subject, calling attention to the negative chemical evidence. My contention was that actual geological facts should be accepted as such and made use of; that the chemical explanation would eventually be found with research, rather than start with our incomplete chemical knowledge and try to force the geologic facts to conform with it. Corroborative geological evidence soon came to hand after the article was published, also some more negative chemical evidence; but, on the other hand, one investigator[6] actually proved, by a series of experiments, a slow solubility of cassiterite with solvents that are likely to occur in the oxidizing zone of the tin veins. A bit of positive proof will always outweigh a mass of negative evidence.

## Practical Aspects of the Process

In Bolivia it is probably true that a large percentage, if not the majority, of strictly primary veins are too low-grade to work. A retrospective view of Bolivian mining will show a great waste of money in useless exploration work that might have been avoided if the principle of secondary enrichment had been understood. Even now much prospecting work is being done that has not one chance in fifty of success. On the other hand, some really promising ground is left untouched. Specific instances may not be cited, for obvious commercial reasons, but some of the more common ways in which this geologic process affects the exploration problem may be shown diagrammatically. The figures are not replicas of particular Bolivian deposits, but, rather, composite pictures built up of parts taken from actual occurrences.

Fig. 3 shows a vein, longitudinal section, in shales and sandstones. Displacement of premineral fault, small, about 4 meters. Width, 20 cm. to 1 m.; average, 40 cm. Some very rich ore in bunches near surface. Becomes low-grade in depth, at from 50 to 150 meters, good ore persisting a short distance into the sulphide zone, the upper portion of which is often fairly rich. Sulphides, pyrite about 10 per cent; other sulphides negligible. The pyrite is not enough to account for enrichment of the oxidized zone on the basis of residual cassiterite. *A*, *B*, *C*, and *D* are exploited orebodies. Tunnels 1 to 4 and Shaft 2 prove low-grade sulphide zone beyond commercial-ore zone. The upper dotted line shows lowest probable surface at the time of vein-filling, but it is likely that it was much higher. It is altogether untenable that the present U-shaped pattern of the enriched zone was produced at the time of primary vein filling (Pliocene?). It is simply a case of secondary concentration paralleling erosion. Tunnel 5 is a long crosscut tunnel being driven farther down the gulch to cut oreshoots *A* and *B* in depth. It is a waste of money. Tunnel 2 has already settled the question as far as *A* is concerned. Nevertheless, from the viewpoint of one who does not accept secondary enrichment, Tunnel 5 is by no means an ill-advised exploration project, since there is no reason, if the pockets are considered as primary, why they may not occur again at lower levels. It shows the importance of having a true idea of the nature of the orebodies. The only exploration warranted in this vein is at the bench of the hill marked *E*. The vein is wider here, more crushed and decomposed. Shaft 1 found ore, but it was too low-grade to work. In this place there was much leaching, and tin ore would probably be concentrated at a lower level. The wider crushed zone suggests a freer circulation of dissolvent surface waters, which is a favorable factor, since it may mean a heavier concentration below and consequently a larger orebody than *A*, *B*, *C*, and *D*, where the vein was not so open. Shaft 1 should be deepened or Tunnel 1 advanced under *E*.

A tin district lying in tuffs is shown in plan in Fig. 4.

[6]Greene: "Solubility of Tin Minerals." *Engineering and Mining Journal*, Sept. 11, 1926, p. 417.

It is traversed by a small river, with tributary gulches as shown. Veins *A*, *B*, *C*, *D*, and E are cassiterite-pyrite veins, the average width being 50 cm. The walls do not seem to show much relative displacement, nor do the veins noticeably affect the topography. They show some rich pockets in the oxidized zone, more uniform commercial grade in the upper sulphide zone, but become lower grade with depth. The tunnel shown in the sketch was driven to prospect a slight surface showing. It cut the vein *X* in friable limonite with about 0.5 per cent tin.

The drift from the tunnel shows the strike of the vein. It does not outcrop, but where it should outcrop the hill slopes are covered with detritus. The gully above the drift, however, was clearly induced by it. The vein was strong enough to impress itself upon a general drainage almost at right angles to it. It will be noted that the other veins did not affect the topography. The drift was finally stopped, and with good reason if cassiterite is conceived as insoluble and secondary enrichment as impossible; for, in that case, the oxidized limonitic zone should be richer than the underlying sulphide zone. However, that vein shows some excellent features. It is wider and stronger than its companion veins. It has undergone great leaching and breaking down action. The topography shows that. Some well-known bonanzas in Bolivia have shown similar limonitic low-grade upper regions. With the idea of secondary enrichment a winze should be sunk into the sulphide zone from that drift. The greatest adverse factor is that the strike of this particular vein differs by about 30 deg. from that of the other tin veins shown on the sketch. It may possibly represent a different mineralization period, and complicates the problem to that extent.

Fig. 5 shows a section of a district in the sedimentaries, across the strike of the principal veins. Many minor veins with different courses are also known, but cannot well be shown here. *A*, *B*, *C*, *D*, and *E* are veins with an average strike of N. 70 deg. E. Average width

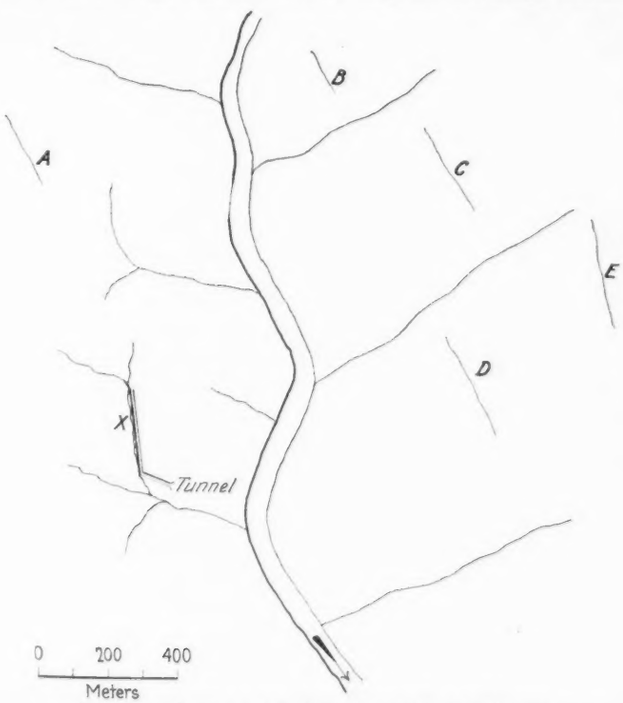



*Fig. 4—Plan of tin district with pertinent topographic features*

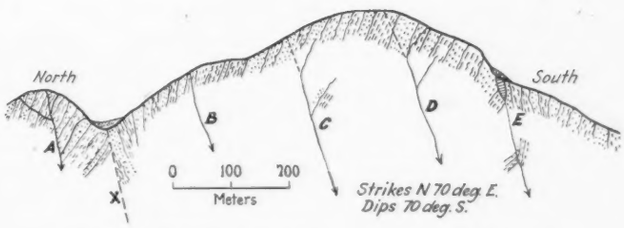



*Fig. 5—Section showing veins, leached veins, and probable veins*

is 50 cm., except *E*, which is 1 meter. *A*, *B*, *C*, and *D* do not show marked dislocation of walls on surface. *C* and *D* do not outcrop, but fringe out before reaching the surface. *E* shows some discordance of strata on opposite walls. The first four veins show only slight secondary enrichment. *E*, on the other hand, shows considerable concentration on the footwall side. The upper part of the vein is leached. Its outcrop near a small bench is covered by drift. It is by far the best of the veins.

Point *X* is near the head of a gulch flowing S. 65 deg. W. Strata on opposite sides of the gulch are markedly discordant. The gulch itself is full of drift, nor is any bedrock exposed beyond its head, except on a ridge about 400 meters away. This ridge shows a small saddle between disagreeing strata. The direction from the head of the gulch to the saddle (somewhat lower) is N. 75 deg. E.

I am giving all these details, because in an area covered by detritus it is only by a synthesis of such data, often apparently irrelevant, that we can get a line on the facts. In this case the bearings given for the gulch and the lower-lying saddle lead one to infer a fault striking N. 70 deg. E. like the veins, and dipping in the same direction as the veins. If this fault should be a vein it would be much stronger than *A*, *B*, *C*, and *D*, and somewhat stronger than *E*, on the basis of its stratigraphic relations. The gulch and saddle, furthermore, determine a length of about one mile, which is much longer than the other veins. Its effect upon the topography presumes a much more decided breaking down and leaching action even than vein *E*. Secondary enrichment should be correspondingly greater. There are no surface showings (since the outcrop is hidden by drift), aside from the fact that, like *E*, it would probably be leached in its upper portions.

I consider the fault *X* a good prospect. It would seem that on this fault something could be done in the way of electrical prospecting. If it were possible to determine that bodies of mineral matter, like sulphides, exist at lower levels of the fracture, as well as their approximate location along the strike, the exploration problem would be much simplified, for in this district and with this system of veins the sulphides, principally pyrite, occur abundantly as mineral associates of cassiterite. Proving the existence of sulphides, proves cassiterite.

## Potentialities of Ore-Producing Batholith Still Largely Intact

The tin districts of Bolivia are distributed throughout a region about 600 kilometers long by 100 kilometers wide. (See map.) This region lies in the eastern range of the Andes and extends from Lake Titicaca on the north to near the Argentine boundary on the south.

Without going into the evidence in this article, it may be said that there is little doubt that the tin deposits of Bolivia are all related to one particular major intrusion of acidic igneous rock, or, in other words, that the tin veins all spring from one great parent batholith,

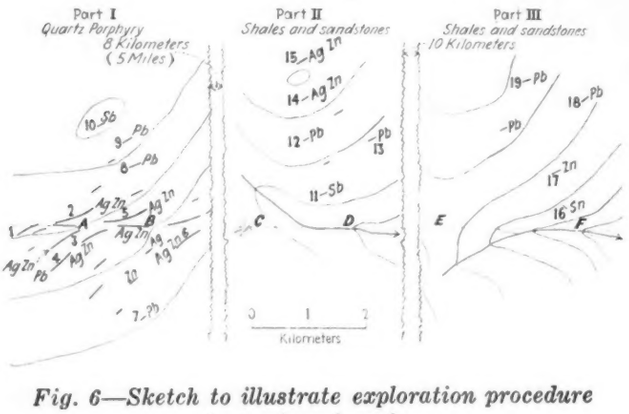



*Fig. 6—Sketch to illustrate exploration procedure in a mineral region*

ranging in composition from granite to granodiorite. This batholith is exposed in only a few places, in the northern part of the region. By far the greater part is concealed by Paleozoic sediments or Tertiary extrusives. In a few limited areas intrusive dikes and stocks of quartz porphyry outcrop. These are presumably high points of the batholith, and in fact are often accompanied by mineral veins. The tin deposits of the region as a whole are still largely intact, since erosion has uncovered but a small part of the great batholith known to be tin bearing. The region is still almost entirely cryptobatholithic.

## Three Principal Geologic Factors in Large-Scale Prospecting

In the foregoing I have stressed three principal geologic factors as having a bearing upon large-scale prospecting. Although many minor factors must be taken into account, these three—concealed batholithic high places, "cupolas"; trunk veins; and secondary enrichment—are the main points on which to hang a preliminary campaign of elimination. All primary veins are due to a favorable combination of the first two factors. The third may be a decisive economic complement of the other two, but its consideration is necessarily a later step.

The first factor, batholithic high points, involves the greatest uncertainty in its determination. I do not believe that the geophysicist can help us much as yet in this direction. About the surest geologic criteria that we have at present are outcrops of intrusive quartz porphyry and vein systems, both of which presumably mark upward bulges of the plutonic mass. There are no geologic maps of Bolivia, but, by locating known high points, some information can be obtained regarding general trends, and certain ridges or spurs of the batholith may become evident.

The vein systems themselves, working the zonal theory backward, throw some light on the subject. In Bolivia it is not uncommon to find veins of antimony, lead, zinc, silver, and tin within a few miles of one another. A progression from tin veins to antimony veins would correspond to a downhill tendency of the batholith. From antimony to lead to zinc, uphill. A mineral district widening out, for any particular metal, shows an uphill tendency toward the wide part. The mineral zones are batholithic contour lines. Sometimes stratigraphic relationships may be illuminating, but as a rule these form rather imperfect criteria, as the batholith is a Tertiary intrusion in an already plicated Paleozoic series. Nevertheless, in conjunction with the already mentioned tests, the structure will often furnish valuable collateral evidence.

The mobile mineral matter or ore magma accumulated in the domes and ridges of the batholithic roof, like the vapor in steam-drums, must have escape to the surface in order to form veins. The trunk conduit, at least in the cryptobatholithic deposits, enters as an essential factor in the geologic equation: ore-magma reservoir + fracture = veins. There are probably hundreds of unscathed batholithic high points which have never been drained and hundreds of adequate faults that have missed crossing an ore-magma reservoir. Field study must have as its objective the localization of the potentially favorable combination of a trunk vein crossing a batholithic dome. No definite rules can be laid down. An analysis of the field picture must suggest the line of attack.

## Field Method In a Concrete Example

As an illustration of the mode of procedure in a concrete example, Fig. 6 may be taken. In this figure the essential features are appropriated from actual occurrences. Part I shows a developed silver district in quartz porphyry. Veins 1 to 6 and *A* and *B* are silver veins with zinc blende as principal associate and with tin generally present in very small amounts. In veins 7, 8, and 9 the principal mineral is galena. Vein 10 is a small prospect with stibnite. Veins 3 and 5 are probably nearest the high point of the underlying dome, not only because they are in the middle of the widest spread of silver-zinc veins, but also because 7 to 3 and 10 to 5 show an uphill tendency of the batholith. It will be noted that the 1 to 6 veins show a decided bending in toward the line *A-B*, but these latter two veins have the same mineral filling as 1 to 6. The *A-B* fault is thus pre-mineral, later than the fractures 1 to 6, and showing by the bending it has produced that it is a fault of major proportions; that is, it has all of the characteristics of a trunk vein.

Part II shows a relatively unimportant outlying district in sedimentaries, about 8 kilometers (5 miles) from Part I. At *C* sandstone is found butting up discordantly against shale; the strike of the fault contact continues into and apparently deflects gulch *D*. *C-D* approximately lines in with *A-B*. Having thus established the persistence of the trunk vein, the next step is to see if the environment is favorable. Vein 11, antimony, to 15, silver-zinc, shows an uphill tendency of the batholith away from the trunk vein, or, in other words, the trunk vein does not lie at the tin end of the zonal column. It is not a favorable combination.

Part III represents an area about 10 kilometers farther along the strike of the fault. A saddle can be seen in a sedimentary ridge, but detritus hides the stratigraphic relations. The saddle *E* lines in with *A-B-C-D*, and on the other side of the ridge the deep gulch *F* also almost falls in this line. Furthermore, about 5 kilometers farther along, but outside of the sketch, a thick growth of *tola* brush thins out very suddenly

along a line approximately the prolongation of *A-B-C-D-E-F*. The sum total of these observations indicates the persistence of the trunk-vein fault.

With regard to the batholith, 16 is an unimportant tin prospect, hardly a vein, but a small seam with bunches of cassiterite between sedimentary beds. Work was stopped by the owner because the ore was too inconstant. No. 17 is a zinc vein, and 18 and 19 are lead-ore veins. No. 19 to 16 show an uphill tendency of the batholith—that is, from lead to tin. This time the trunk vein is at the tin end of the zonal series. Conditions are potentially favorable. It also shows conditions that might favor secondary enrichment; for example, the fact that the trunk vein is in the gulch itself. The area should also be searched for lesser fractures parallel to 17, 18, and 19, but on the other side of gulch *F*, having in mind the occurrence of blind veins. *F* to *E* might be electrically tested.

In Part II the surface topography is parallel to the batholith, accentuating its effect as compared with a level surface and diminishing the spread between zones. In Part III the surface relief compensates that of the batholith, and the effect is to widen the spread between zones.

### The Point of View in Previous Exploration

Development of the Bolivian tin field has been largely due to Chilean initiative and to the enterprise of the Bolivian tin king, Simon I. Patiño. Many Chilean companies have been formed on the basis of properties insufficiently developed. The tendency has been to be too optimistic over the possibilities of downward extension of rich pockets of surface ore and to begin the construction of a mill long before it was warranted by the proved reserves or even the reasonable prospects. Available capital was expended on the concentrating plant with the purpose of getting to the producing stage as quickly as possible, which might give the shares some standing on the stock market. Naturally, upon completion of the mill, without adequate reserves, exploitation soon took on the character of a hand-to-mouth scratch for ore, and only development work giving promise of quick results could be undertaken.

Most of the tin properties of Bolivia started as grass-root prospects, excepting previously worked old tin-silver districts like Oruro and Potosi, where the tin-bearing ores had been left by the early Spaniards. Some of the more successful ventures were lucky to find blind veins or blind extensions. The point I want to bring out, is that the development so far has been merely following up some grass-root beginning, and no far-sighted exploration based on purely geologic reasoning, like that at some of the big copper properties of the United States, has ever been attempted. Nor would an exploration project presenting a cold-blooded balance sheet of the pros and cons, with the mill relegated to the background, have met with much acceptation. The mental attitude based on a mining tradition that dates back to the time of Atahualpa would not be propitious to that kind of a long-range proposition. It is necessary, when appraising the possibilities of this tin region as a whole to take these psychological antecedents into consideration, for it will give a line on the prospects that have been thoroughly tested out and the type that has been neglected.

The grass-root field has been thoroughly gone over, and since the mineral regions of Bolivia are covered by only a sparse vegetation, any surface showings have been found long ago and probably have been developed. This quick-result field is practically exhausted. There remains, however, the great, almost intact field of the concealed deposits, such as the veins hidden by later formations or detritus; the blind veins; the leached veins. To find these requires exploration of a different order to that heretofore attempted, as well as a different mental attitude. The problem must be attacked along broad lines and with eyes open, somewhat after the manner and with the spirit of the oil men. Negative factors must be duly weighed and not hushed over or softened down, as has been the tendency so far. It is large-scale work, but the prizes that await success are in proportion.

### Geologist Must Conduct Initial Investigations

I have laid stress upon the geophysical methods, because with concealed deposits these will undoubtedly be called upon to play an important rôle, but in any event the geologist must precede the geophysicist, and the field will have to be greatly narrowed down and an enormous proportion of ground eliminated before the latter is called in. Aside from the purely geophysical aspect, however, large-scale prospecting based on geologic criteria as outlined above is warranted on its own merits. Its object is to sift out small areas showing favorable conditions from a much more extensive region. Some of these areas may be of sufficient promise to warrant immediate underground work or drilling; others might be favorable for preliminary geophysical testing in the present state of the science; still others may present conditions that may be regarded as favorable, but for technical or other reasons may not be suitable for immediate closer exploration. But even with this last-named class the information itself is valuable for possible future use, and it does not draw interest.

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## Poland Is Rapidly Developing Her Potash Resources

The phenomenal development of the Polish potash industry during the past half-dozen years is revealed in a trade bulletin issued by the U. S. Department of Commerce. Before the war, Poland consumed each year about 400,000 metric tons of potash salts, practically all of which was imported from Germany. Though a Polish company was organized in 1914 to develop the resources of Galicia, its production was negligible until 1917, when it amounted to about 10,000 metric tons. Since that year production has rapidly increased, until in 1925 the amount of potash salts produced reached 151,000 metric tons.

Polish potash consumption is still far behind that of pre-war years, but every effort is being made by the government to increase the use of fertilizers among the farmers. Instructive literature is being widely distributed; concessions in freight rates are granted; and credits are being made available. The demand is growing constantly; and if agricultural development in Eastern Poland can gradually be brought to the high level already obtained by parts of the country which were formerly German, the potash-salt requirements of the industries of the nation will soon exceed the pre-war consumption.

# Madagascar Government Arranges to Guarantee Graphite

THERE are two big centers of production of graphite in the world—Ceylon and Madagascar. The industry of the latter is younger, but the future is very bright, for many reasons. Shortage of labor is being overcome more and more by the introduction of machinery; shipping facilities are improving; and it is now possible to ship graphite on a through ocean bill of lading from Tamatave to New York, according to the Commercial Attaché of the French Embassy in New York. The real strength, however, of the graphite industry of Madagascar lies in the wealth of the deposits and the steps taken by the French Government for the standardization of the product.

The extent of graphite resources in the French colony is discussed in the report of an engineering commission which visited the deposits there about a year ago. The three following paragraphs are condensed from the report:

"Statements as to the large reserve of graphite existing in the island have not been in any way exaggerated. Most of the claims seen were within fairly easy reach of the railway or canal; and transport could be, and is, in some cases, being rendered much more simple, particularly in doing away with transportation by men. Claims being worked at present are owned by Frenchmen or by companies that seem to be able to acquire all the claims in an area, so that the working of their mines is not interfered with by others. The ore is variable in its richness, most of it appearing to contain from 10 to 12 per cent of graphite, but one owner stated that the ore contained at least 40 per cent graphite, and it certainly had a very rich appearance. The lodes or seams dip only a few degrees from the horizontal and resemble a seam of coal rather than a vein of plumbago as seen in Ceylon. They have a general direction of north and south with a dip to the west. They all appear to extend for many kilometers in length and are of great width.

"The thickness of the ore beds does not seem to have been proved in many cases, it being sufficient for the purpose to have from 10 to 20 m. workable without going below water level. More than 2 or 3 m. of overburden is seldom encountered, the reserves being such as to allow of choosing the easiest worked parts. This also applies to selecting the richest parts of the deposits to be worked, the less rich or more difficult portions being left for the future. In some places a certain amount of mica is observed, mostly on the upper part of the lode, and this portion is simply discarded, as it is found very difficult to separate mica from flake graphite. The ore generally worked consists of graphite and silica, and is of such a soft nature that nothing but a shovel is used for excavation. Separation, though very wasteful, is extremely simple. The conclusion arrived at is that this graphite can and will always be worked cheaply, the costs of production being below anything that Ceylon could possibly attain.

"Machinery for production by means of water and for refinement is being more and more introduced, thus reducing the number of workers required. If all the difficulties in the way of transport, shipping facilities, and labor are overcome, so as to enable Madagascar to increase her export of graphite to anything approaching her ability to produce, it is difficult to see how Ceylon can possibly compete with this country."

American importers had often complained about the lack of grading in Madagascar shipments; but of later years the producers have made great efforts to improve their methods of treatment, and with satisfactory results. As early as 1922 the French Government instituted an official commission, which established a recognized standard, for which an official stamp affixed to a lead seal is granted. The application of this stamped seal, which guarantees the grade, is not so widely used as it might be, owing to the majority of the miners being small concerns and not very careful regarding such regulations. However, larger companies have been and are being created, and one of them is extracting more than 1,000 tons per month. Producers for the most part are anxious to have the present official grading further extended; and it is therefore urged that importers include in their contracts a clause stipulating that all shipments bear the official stamped seal. This should prove in the interest of all concerned.

For the benefit of importers, the service created in Madagascar is as follows: Samples taken from various bags are thoroughly mixed; two samples of this mixture weighing 200 gm. each are then sealed. One is kept for one year by the customs house; the other is sent to the chemical laboratory. If the shipper applies for the official stamped seal, the laboratory then analyses the sample he has received. If this proves to be up to the standard the customs officer seals each bag with lead and affixes the official stamp bearing the words: "Graphite Standard Madagascar No. 1." This guarantee is based on the following specifications:

1—Ash contents less than 13.5 per cent.

2—Proportion of the product not passing through a 60-mesh sieve, 98 per cent.

3—Conformity to standard regarding aspect and touch.

Consignments of graphite not up to the above standard can also receive seals but not the official stamp:

1—One seal merely guarantees that the contents of the bags conform to the respective samples.

2—A second seal guarantees further that the contents in ash are less than 20 per cent but more than 15 per cent.

3—A third seal guarantees that the contents in ash are less than 15 per cent.

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## Mill Dewatering Unit Automatic

Water for the plant of the Atolia Mining Co., at Osdick, Calif., must be hauled a distance of 65 miles by rail. Economy in its use is therefore a matter for consideration. This circumstance, added to the fact that control of pulp density is desirable, led the company to install an automatic density valve. This is attached to a gravity settler. The pulp from the mill is pumped into one settler, the automatic valve discharging 50 per cent solids by weight as underflow through ten mesh. The overflow from this settler is decanted to another settler, to which is attached another automatic density valve. Here the underflow is automatically maintained at 70 per cent solids, this material being principally the slime in the overflow from the first settler. Owing to the automatic feature of the valve, it was necessary to install an automatic float switch in the sump into which these valves discharge. This makes the complete dewatering unit of this mill entirely automatic and permits an economy that is impossible with the manual valve.

*Dry concentration mill at the Summerfield tungsten property near Mina, Nev.*

# Tabling Tungsten Ore Without Water

## *Small-Scale Plant in Nevada Proved a Metallurgical Success, Though 1 Per Cent Ore Did Not Allow Profitable Operation*

**By Walter X. Osborn**
Formerly Manager of the Lezeart Syndicate

MY FIRST EXPERIENCE with dry concentration was in connection with the concentration of scheelite, at San Nicholas, Sonora, Mexico, in the latter part of 1918. This was at a small tungsten property owned by the N. I. S. Syndicate, of Douglas, Ariz. At that time the property had produced about twenty tons of 60 per cent scheelite concentrate per month for about two years. Nearly all of this was obtained by hand sorting and large dumps of second-class ore had accumulated that required some kind of milling treatment. The mine was situated about 200 miles from the nearest railroad shipping point, and all material had to be packed on mules, so that it was difficult to take any heavy machinery to the mine. Conditions were very unsettled at that time, and it was necessary to use some type of machinery that could be transported without too much difficulty. Therefore, a small portable type of Stebbins dry table was purchased and packed into the camp on mules. It had a capacity of about one ton of dry feed per hour and was driven with a small 2-hp. gasoline engine, belted directly to the table.

The machine was set up on the dump without any building or cover and was in operation in less than three hours after it arrived at the property. Its feed consisted of screenings taken from the ore as it came from the mine, together with screenings from the dump. The table feed all passed through a 10-mesh screen and was concentrated without further classification. In November, 1918, this small table ran for a total period of seventy-four hours and produced 5,589 lb. of concentrate that assayed about 61 per cent $WO_3$. In the first half of December it ran sixty-four hours and produced 6,027 lb. of concentrate of about the same grade. A test run was also made of the surface dirt directly below the mine. This was a rather heavy red dirt, of clayey loam and rather damp. It was screened and run over the table without being dried, 10,000 lb. of this dirt producing 265 lb. of high-grade scheelite concentrate. No tailing assays were made, although the tailing was frequently panned and showed very small tungsten losses. The entire outfit was crude and simple, but it did remarkably good work.

In August, 1924, the Summerfield tungsten property, situated near Mina, Nev., was brought to my attention, and after a brief examination, which indicated that the property apparently had considerable high-grade ore developed, a lease was taken for the Lezeart Syndicate, of Evanston, Wyo. The Summerfield tungsten mine is situated in the Shoshone mining district, on the east slope of the Pilot Range and about 23 miles from the town of Mina. The ore occurs as scheelite,

disseminated through beds of garnetized lime; it also occurs in fissure veins, close to and at the contact of lime beds and granodiorite. When I visited the property, a fissure vein had been opened up for several hundred feet and crossings driven into flat beds of garnet and lime which were reported to assay about 2 per cent $WO_3$. Ore exposed in the vein was said to average from 3 to 10 per cent $WO_3$. The owner of the property claimed a considerable tonnage of ore that would average not less than 4 per cent $WO_3$, and this claim was corroborated by the report of a mining engineer who had apparently had considerable experience with this type of deposit and who had sampled it extensively, and further by a test shipment of thirty tons of ore that milled 8 per cent $WO_3$.

For financial and other reasons it was desirable to get into production with a small mill of about twenty-five tons' capacity per twenty-four hours, and with the lowest possible expense. The mine was situated so that no considerable amount of water had been developed in the immediate vicinity, although there is a large spring several miles distant from it. A dry-crushing and concentration test was first made. A sample of several hundred pounds was sent to Los Angeles and ground in a Herman ball mill to 20 mesh. This product was then treated on a Stebbins dry table, giving a concentrate that assayed 73 per cent $WO_3$.

### How the Dry Table Is Constructed

The Stebbins table consists of a hollow metal table having riffles made of metal and punched with very fine slots between the riffles. A fan delivers air to the interior of the table, which latter runs at a high speed with a motion that is a series of short forward impulses. A ridge extends along the upper side of the table, the riffles leading to this ridge. The table is inclined so that both discharge end and the side with the ridge are considerably higher than the feed end, and when the table is in motion the pulp rides on a cushion of air. Most of the fine dust and the lightest part of the pulp are discharged on the lower side of the table very close to the feed end and the heavy particles are carried forward and upward toward the ridge at the top of the table. As the stream of pulp moves forward to the discharge end of the table, a stream of concentrate gradually builds up, which crowds middling down on to the table, so that by the time the discharge end of the table is reached, there is a ribbon of clean concentrate from an inch to several inches in width, according to the richness of the feed pulp. A movable divider cuts the stream at the discharge end, and in practice it is not attempted to save the full width of clean concentrate, but part of it is allowed to go into the middling, which is fed back to the head of the table by an elevator. The table has a metal cover with a series of removable plates, although the lower end is open for inspection. Near the upper end, where practically all the dust occurs, is a connection for a 6-in. suction fan which draws off the finest dust. The tailing side of the table discharges into a hopper covered with a canvas flap. This hopper leads direct to a belt conveyor situated below the floor of the table room. The tables have dust-proof bearings and stand up well, but consume considerable power, requiring about 4 hp. each. They have a large capacity, however, as a large-sized table will handle from one to three tons of material per hour.

Tests having determined that the dry table would separate the garnet from the scheelite, a small pilot mill was built at the mine. This consisted of a 5x7-in. Dodge crusher, a belt conveyor from the crusher to the ore bin, a 10-ton ore bin, and a 3x3-ft. Herman ball mill (old style), the ball mill discharging directly into a ground-ore bin of about fifteen tons' capacity. The ore, ground to 10 mesh, was fed directly to a large-size Stebbins dry table having a capacity, on this class of ore, of about one ton per hour. The table made three products, a 15 per cent concentrate, middling, and tailing. Middling was carried to a bucket elevator, which discharged it back in the crushed-ore bin, mixing it with the ball-mill feed. The concentrate was stored until several tons was accumulated, whereupon it was concentrated on a smaller Stebbins table and a 60 per cent $WO_3$ product made. A much higher-grade product could have been made, but this was unnecessary for market requirements. The fine dust from the suction fan was discharged into a pipe leading through the roof of the mill, no dust collector being installed.

### Ore Proved Low Grade

When the mill was put into operation several unexpected difficulties arose. The most serious was the low grade and bad character of the ore. On mining in quantity, the ore proved to be very spotty, and instead of giving a mill feed of 4 per cent $WO_3$ or better, the feed for the first month of operation barely averaged 1 per cent. The mine was very deceptive. At times we ran into bunches of very rich ore; at one time we had several feet of ore that would run 15 per cent $WO_3$, but the next round shot it out. Ore that runs ½ of 1 per cent is identical in appearance with ore that runs 2 or 3 per cent and often when a sample taken over a face would indicate that we could break 2 per cent ore, the broken ore would not average over 1 per cent, or even less.

To insure the proper working of a Stebbins table and to make clean concentrate, the table has to make a band of concentrate at least an inch or more in width, which can be done with an ore assaying 4 or 5 per cent, but with an ore assaying 1 per cent, only a mixed low-grade concentrate can be made, that has to be reconcentrated. In this case, this low-grade concentrate consisted of a mixture of heavy garnet and scheelite and the light dust and lighter material that would give a good bed on the upper part of table was already taken out. In reconcentrating on a separate table, it was possible to make a high-grade product, but difficult to separate the fine scheelite from the coarse garnet, and the tailing had to be run through the machine several times; even then it contained 2 or 3 per cent of fines. This trouble could have been eliminated by treating the concentrate on a high-intensity magnetic separator, which would have given a clean tungsten product with practically no fines loss. With a higher grade of mill feed, clean concentrate could have been produced in the first operation and recleaning would have been unnecessary.

### Dust Was Troublesome

Considerable difficulty was experienced with dust. Although the suction fan drew the dust off the table, a considerable amount was made by the dry ball mill. This ball mill was inclosed in a housing, but the top of the crushed-ore bin was open. We later closed this in and installed a larger suction fan, running pipes to the ball mill and ore bin, thus reducing the dust to a

point where it was no longer serious. The clean-up table made a lot of dust, as it discharged on the floor of the table room instead of into a closed hopper, because it was necessary to run the tailing through the machine several times. This dust would not have been produced with a magnetic separator. By properly inclosing the pulp at all points where it is in motion, and having a suction fan of sufficient capacity discharging into a dust collector, dust can be almost entirely eliminated in a dry mill of this type. By treating this dust on a small wet slime table or on dry slime tables that are made especially for such material, the greater part of the valuable mineral in the fines can be saved.

A typical analysis of mill feed and tailing, taken on a test run of two days, gave interesting information. This test was made particularly to determine the losses in fines, so for that purpose a screen analysis was made of the feed and tailing and the different products were assayed separately for tungsten content.

**Mill Feed**

| Mesh | Per Cent of Total Weight | Assay, Per Cent $WO_3$ |
|---|---|---|
| On 20 | 36.20 | 0.83 |
| 40 | 28.50 | 1.10 |
| 60 | 13.39 | 3.17 |
| Through 60 | 21.5 | 4.33 |
| Average | | 1.98 |

**Mill Tailing**

| | | |
|---|---|---|
| On 20 | 41.7 | None |
| 40 | 27.0 | Trace |
| 60 | 13.0 | 0.90 |
| Through 60 | 18.3 | 1.37 |
| Average | | 0.36 |

Mill recovery, 81.89 per cent.

It may be noted from this assay and screen analysis that the fines passing through 60 mesh carried about 47 per cent of the total mineral in the ore and that it was in the fines that the greatest loss occurred. The assay of this minus-60-mesh tailing was only 31.63 per cent of that of the same size material in the feed, the loss being 12.66 per cent of the total mineral in the feed, which would compare favorably with slime losses using wet concentration.

A special type of dry table is constructed to treat slime so that by screening out the minus-60 material with a vibrating screen this loss could be reduced materially. It was suspected that a considerable loss occurred in the dust discharge into the atmosphere. A general sample was therefore taken of the dust accumulated on the roof and on ledges around the mill, this giving an assay of 0.73 per cent $WO_3$. This was lower than the mill feed and the amount of the dust blown away compared to the total bulk of the ore treated was so small that this loss was almost negligible. A large amount of the tailing was screened through a 40-mesh screen and the product treated over a small wet slime table, but the recovery of tungsten was so small that it did not pay the expense of handling the material. About 500 tons of ore was treated in this small test mill. Unfortunately, the expectation of getting mill feed that would average 4 per cent $WO_3$ did not materialize, the total average for the entire run being not over 1.1 per cent, which, on such a small tonnage, was not profitable, and operation was suspended. There is apparently a large tonnage of 1 per cent ore in the mine which would be profitable if milled on a large scale, and the company now operating the property is planning on erecting a plant of larger capacity.

The mill run demonstrated beyond question that dry concentration is a success on ores of this type. The plant layout is simple, as the ore does not require sizing and in most instances does not require finer crushing than 10 mesh. A dry mill can be readily erected in places where water cannot be obtained for wet crushing, and the cost of erection will generally be less than the cost of a similar plant employing wet crushing. Dust is always the big objection in dry milling, but proper design will entirely eliminate this. This fact is proved in the Ford power plant at River Rouge. Powdered coal is used in this plant, and the attendants wear white duck suits, which they are able to keep clean, proving that no dust whatever escapes into the building. On ores that slime badly, like scheelite, the total saving with dry tables will exceed the saving that can be made with wet methods, except where it is possible to use flotation. In wet mines it would be necessary to dry the ore, although in mines where there is only natural dampness enough heat is generated in the ball mill to dry the ore to the extent necessary for the dry table.

**Safety First**

*Goggles are used by drill runners and helpers in the mines of the Tri-State zinc and lead district. Many eye injuries are thus prevented*

# Useful Operating Ideas

## The Duplex Belt System for Conveying Materials

By B. E. Mix
Chief Draftsman, Utah Copper Co., Salt Lake City, Utah

CONVEYING MATERIALS by means of a rubber belt has for more than forty years been accomplished by using various widths and plies of duck and vulcanizing to these bodies different thicknesses of rubber covers, which protect the canvas or webbing from the abrasive action of the material being conveyed. These covers cannot be replaced nor repaired, and when worn out the plies of duck are rapidly destroyed by abrasion. The relative wearing values of ¼-in. best-grade rubber covers as compared with six plies of duck is 85 per cent on rubber to 15 per cent on duck. In other words, on a belt which conveys 1,000,000 tons of coke, trap rock, ore, and other abrasive materials, 850,000 tons would be conveyed on the ¼-in. rubber cover before it is entirely worn away, whereas only 150,000 tons would be conveyed on the duck belt.

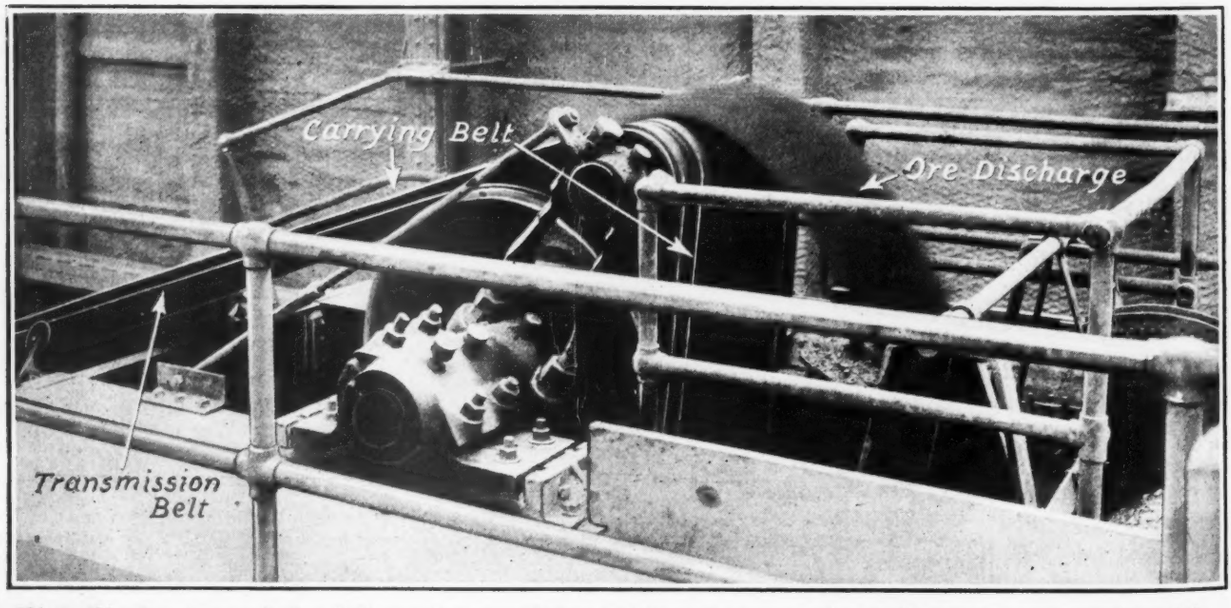
In handling hot materials such as coke, clinkers, and finished cement, the temperatures rapidly over-vulcanize the covers and the duck "carcass," thereby destroying the whole belt in a short period of time. This destruction takes place even when the abrasive action of the material is not severe. The belt is simply "burned up."

Realization of the economic weakness of the old-style conveyor belt has resulted in there being placed on the market a so-called duplex system of conveying. This system is one of the greatest improvements in conveying equipment since rubber belts were first designed for moving materials.

A duplex-type conveyor belt was installed in the secondary coarse crushing department at the Magma plant of the Utah Copper Co., and represents an innovation in belt conveyors. It differs from the usual type of conveyor belt in that it consists of two separate units, which is a combination of a transmission belt and a wear-sheet, one of which is made up of a number of plies of fabric necessary to transmit the load, and the other a straight rubber belt upon which the product is carried. The transmission belt is 30 in. wide, and travels over the idlers and around the head and tail pulley in the usual manner, and the rubber wear-sheet, which is 36 in. wide, rides on top of the transmission belt in the same manner as the product which is being carried.

### INCREASED LIFE AND SERVICE

The purpose of the duplex belt is primarily to obtain a greater measure of service, or increased life, based on the known fact that the fabric part of a conveyor belt is usually in good condition after the rubber coating is worn off. In the application of the duplex belt, when the rubber wear-sheet is worn out it can be replaced with a new one, the transmission belt being permitted to remain in service until worn out. The accompanying illustrations show clearly the application. The transmission belt passes around a common type head-and-tail pulley, whereas the rubber wear-sheet is passed over separate smaller pulleys mounted diagonally above the main pulleys. The purpose of this arrangement is to keep the two belts in alignment, the small pulleys on which the wear-sheet passes being heavily crowned and provided with means to permit proper adjustment. This arrangement also relieves the wear-sheet of the strain which is produced in transmitting the load. In other words, it is free to ride on the transmission belt and to act as a carrier of the product only.




*View showing transmission belt passing over large pulley and ore-carrying belt passing over small pulley*

The smaller pulleys over which the wear-sheet passes permit a free discharge of the product, whereas in the case of an ordinary conveyor, with the product discharging from a much larger diameter pulley, there is a tendency for the product to slide on the belt after it passes the top center of the pulley. This free discharge feature of the duplex belt also delivers the product far enough away to prevent rebounding particles striking back on the belt. These advantages, although of secondary importance, tend to add additional life to the carrier belt.

### TANDEM-PULLEY DRIVE

This belt conveyor is driven by tandem pulleys near the tail-end, with the transmission belt only passing over these pulleys. The wear-sheet is by-passed under the driving pulleys and joins with the transmission belt again at the tail pulley. The transmission belt is tightened with the usual type of tail-end take-up without producing any ill effects on the wear-sheet.

On account of the wear-sheet being in the under side when passing over the return idlers, it has greater sag than the transmission belt, thereby providing sufficient natural take-up of the carrier belt. Both belts are spliced alike in the usual manner with ordinary belt fasteners.

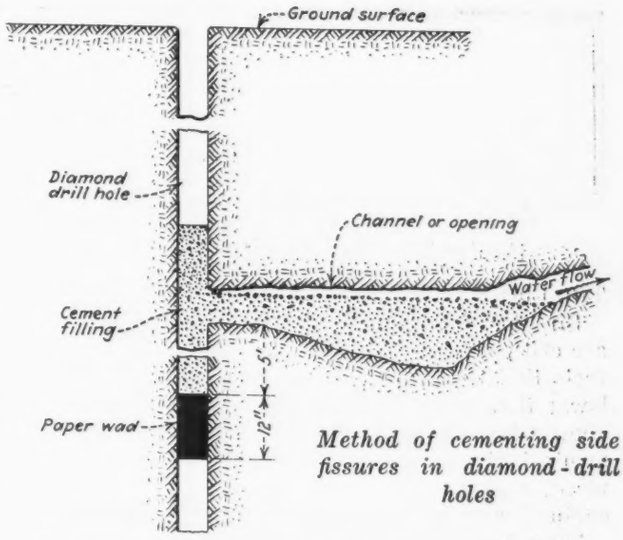
This installation has been running about one year, and has given entire satisfaction. It is still in such excellent condition that its ultimate life cannot be determined at this time. It appears safe to say that it will be far greater than could be obtained with the usual type of conveyor belt in like service. To date this belt has handled approximately 2,500,000 tons of ore, the maximum size of which was about two inches in diameter.

## Removing a Key from Shaft Keyway

By Charles Labbe
Clarkdale, Arizona

The removal of a key from a keyway in a shaft is seldom easy, and before attempting to remove one which is rusted or apparently difficult to start, apply a penetrating oil mixture, consisting of half kerosene and half turpentine to which a very little light lubricating oil is added. To start the key with a key drift and hammer, the blows must be hard and positive, as light blows have a tendency to upset the end of the key, which would make matters worse. Starting with a long key drift may not be successful, because the blows are not in a straight line and often the heavy blows needed just bend the tool out of shape. A good tool for starting a key is made, as shown in the accompanying sketch, of tool steel of ample size; when hitting it with the hammer there is no chance of bending, it as the blows are more in a direct line. When the key starts more lubricant is applied and the longer key drift can then be used, as the hardest part of the work has been done once the key has been moved.

*Tool for starting a key*




*Method of cementing side fissures in diamond-drill holes*

## Cementing Side Openings in Drill Holes

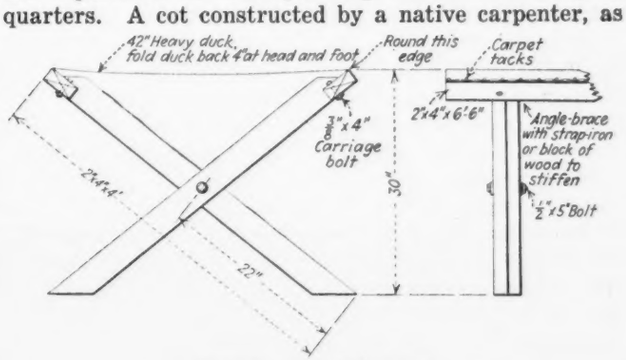
By Roy H. Poston
St. Francois, Missouri

Natural caves or crevices that are penetrated by diamond-drill holes allow the mud to flow into the hole, and cuttings from the drill bit accumulate therein. It is desirable to shut off these openings. This is accomplished by the use of cement, which after setting must be drilled through to permit completion of the hole. To prevent re-drilling below the lowest opening, the hole is plugged with a paper wad at the point desired to stop the cement. This is indicated in the accompanying sketch. This method is in constant use in the southeast Missouri lead district.

## Camp Cot Simply Constructed

By F. D. Wrye
Vallejo, San Luis Potosi, Mexico

A summer's stay in the back country of Mexico gave me experience in extemporizing comfortable sleeping quarters. A cot constructed by a native carpenter, as


42" Heavy duck, fold duck back 4" at head and foot
Round this edge
Carpet tacks
2"x4"x6'6"
Angle-brace with strap-iron or block of wood to stiffen
7" x 4" Carriage bolt
30"
22"
½" x 5" Bolt

*Details of folding cot*

shown in the accompanying sketch, proved especially satisfactory. It was used with a single-bed mattress. It is necessary to have the height of the canvas 30 in. above the floor to avoid dirt and insect pests. Necessary supplies for making the cot can be readily packed in any outfit. Ordinary folding cots are not satisfactory. I also found that the new insecticide applied by atomizers was especially satisfactory and effective even for larger insects such as cockroaches, which are either killed or discouraged.

# Discussion

## Protection for Mining Engineers

THE EDITOR:

Sir—Not laymen only but lawyers and judges also, are criticising our laws and their administration. The facts that the statute books are crammed with useless laws; that many of them are so inefficient that they allow a large proportion of criminals to escape punishment; that procedure allows technicalities too large a place; and that the courts are largely inefficient, are calling for reformation by lawyers themselves.

They have not only administered the laws, but for years have made them, and have largely conducted the government. They have had a free hand, without interference from other professions, have expended an extraordinary amount of effort, and now admit much of that effort was wasted.

Mining engineering, on the other hand, has taken an industry that was formerly classed as a gamble and made of it a legitimate business. This cannot be denied as regards the larger and more important operations, and there is no more gamble in the smaller ones than in other forms of business and industry.

In the one profession, inefficiency is growing more inefficient. In the other, just the opposite is the case, yet the inefficient profession presumes to criticise the efficient.

In the strict sense of the word, money is lost only when it is destroyed. If it is "lost" by one man to another its purchasing power still remains. The largest loss the world knows is in effort and material. Loss of effort is total except for the small saving in the form of experience. There is nearly the same percentage of loss of materials.

But, as "Engineer" points out in the Dec. 25, 1926, issue, of the *Engineering and Mining Journal*, it is the lawyers, dentists, attorneys, doctors, judges, insurance agents, public prosecutors, railroad men, professors of law, and the like who cause the greatest losses in the mining business.

The prospector is not necessarily a good judge of the value of his property. We all know of prospectors who delayed development by insisting on a price of a million dollars, or some other outrageous sum; and we have seen, time and again, those same properties fail to make good when the locators died and the property came into new hands.

The lawyers, no doubt, would like to see the "good old times" when mining property was offered for sale at a set price, regardless of its value; when promoters bought at the set price, and then proceeded to get their money back, and then some, by selling stock to the public; and if there was a loss it was borne by the gullible stockholders.

I have been and am acting as agent for the sale of properties. The larger the price paid to owners, the larger my commission. But I have refused to handle property on which an arbitrary valuation is set by owners, and my services have proved satisfactory.

The engineer who knows the arbitrary valuation of a property he is asked to examine also knows it is almost always out of reason. He is more liable, in such circumstances, to try to prove an excessive valuation than to determine the real value. I do not say he does so consciously, but I do say an antagonistic idea is planted in his subconscious mind.

After he has made his report, if the buyers are in mining as a business, as opposed to selling stock as a business, they will offer a price based on the report, regardless of the owner's figures. I believe it is more fair to allow examination and valuation by the engineer, the buyer then to submit a tender, and if he and the owner cannot then negotiate the price no one is any the worse off. But I am anxious that the engineer shall not approach the examination with any idea of a set price in mind.

Not only are all the professions except mining engineering protected by law, but in many states no one may cut another's hair, or shoe a horse, or fire a boiler, for pay, until he has been examined and passed as efficient. I wonder if the lawyers who criticise E. M.'s go to some worthy and needy person who owns a pair of shears, but who has never learned to use them properly, when they need their hair cut!

Not having been admitted to practice at the bar, which of course would qualify me as an authority in any other profession I might want to enter by the back door, I haven't the nerve to give myself the degree of Practical Mining Engineer. I am merely a miner. But I want to ask why E. M.'s should not have the same protection in their profession that lawyers have in theirs?

F. B. M.

Pueblo, Colo.

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## Chile's Bookkeeping

THE EDITOR:

Sir—In your issue of Jan. 8, 1927, there appeared an editorial under the heading "Chile's Bookkeeping," which contained the following statement: "By the accounting system employed, the value of unsold copper ready for market does not enter the financial statement, although the full cost of producing it is charged against operation."

The foregoing statement is mainly incorrect. It is true that we do not credit the value of unsold copper to profit and loss, but we do not, as stated, charge operations with the cost of producing such unsold copper. The unsold copper is charged to an inventory account at production cost until sold. The surplus-account figure which appears in our published reports reflects only the profit from actual sales made within the period.

We are inclined to think that you have confused our method of accounting with that of some of the other large copper-producing companies who follow, in part, the procedure you have assumed to be ours.

New York.

H. C. BELLINGER,
Vice-President.

## Meteor Crater

THE EDITOR:

SIR—In the Nov. 20 number of *E. & M. J.* F. LeRoi Thurmond raises again the question of the origin of the crater near Canyon Diablo, Arizona, which is now called Meteor Crater, because of the theory that it was made by the fall of a great swarm of iron meteorites. He decides that "It is perfectly conceivable that the crater was formed by an explosion of superheated steam due to the invasion of the Coconino sandstone by an intrusive mass that does not come to the surface." Now, in science an explanation should not be accepted because it is conceivable, but only if it is probable. This cannot be shown of the steam-explosion hypothesis. The probabilities are all in favor of the meteoric hypothesis, and they are so strong that the proof of this hypothesis rises to practical certainty.

The fall of the meteoric swarm and the formation of the crater took place not only in the same square mile on the earth's surface, but in the same three seconds of time in the world's history. Mr. Thurmond is willing to believe that this coincidence is accidental; but the simplest estimate shows that the odds against this view are of the order of a billion billion to one. This enormous probability is in favor of the meteoric as against the steam-explosion hypothesis.

The strata exposed in the walls of the crater are tilted in a curiously symmetrical manner on both sides of a vertical plane passing through its center. The ejected materials are also distributed symmetrically with respect to the same plane. The south wall for 2,700 ft. is only slightly tilted, but is lifted bodily 100 ft. Such a hole could be made by a massive projectile coming obliquely from the north, and burying itself under the south wall. It is very improbable that it would have been made by an internal explosion.

Vast quantities of sandstone shattered to very fine powder were formed when the crater was made. Superheated steam in sandstone might have blown the rock to pieces and made sand, but it would not have shattered the individual grains to powder. Quartz crystals do not absorb water. The shock of a great swiftly moving mass would give just the shattering blow needed to produce this formation. Some of this powder has been melted in the presence of water and puffed up into a formation something like pumice. This often carries iron-nickel stain, showing that iron-nickel vapor was formed near it. Hot steam does not melt quartz or vaporize iron; but an iron mass grinding through rock would naturally produce local high temperatures which would do both these things.

Mr. Thurmond's "intrusive mass," which he thinks occasioned the assumed explosion, does not show on the surface and was not found by any one of the twenty-four drill holes which were sunk through the floor of the crater. Eight of these drill holes were carried down into the Red Beds, and in every case the rock of the Red Beds was found unbroken and the strata undisturbed. It is highly improbable that such an intrusive mass is there.

Finally Mr. Thurmond says that "the meteor has not been found, although much exploration has sought to discover one." This is no longer true. The earlier borings made through the floor of the crater found meteoric material, but no large mass. A drill sunk on the southern wall, where later study showed the meteor was to be expected, encountered at a depth of 1,370 ft. considerable quantities of meteoric iron, containing nickel, and traces of the platinum and iridium which the meteorites on the surface show. This material could not have reached so great a depth except as a part of a much larger body. The part reached possesses the characteristics predicted for it, and justifies the assertion that the meteor has been found.

Investigation of the mass and the composition of this buried meteor is still to be completed. The mass that made so great a crater must have been great, and there is no reason to think that its composition is different from that of the specimens of it which lie about and in the crater. Further exploration to settle these points is very important, not only because of the scientific interest of the matter but because there are reasons to believe that the mining of the great mass would have large commercial possibilities. WLLIAM F. MAGIE.

Princeton, N. J.

## Precipitation of Ores

THE EDITOR:

Sir—Referring to the occurrence of barite in the vein systems of Southeast Missouri as discussed in the *Engineering and Mining Journal* of Jan. 14, 1927, considering the highly insoluble character of barite and also of the sulphides of the metals occurring in mineral veins, it is obvious that the barite and also the sulphides of the metals did not come into the veins in that state, but were precipitated from some more soluble form at the point when found.

It becomes, therefore, necessary to know what salt of the barite and the metals existed previous to the precipitation. The chloride of barium is soluble in water and so also are the chlorides of all the metals, with the exception of silver; and that is soluble in salt water. The chlorides of all the metals are volatile at varying temperatures, and the presence of chlorine has been shown in volcanic gases. It therefore appears that the mode of collecting the metals from magmas in which they may occur only as traces has been as volatile chlorides which have later been precipitated as sulphides in the veins, when and where the temperature has fallen below the critical temperature of water. $H_2S$ will not form from the reaction $6H + SO_2 + H_2O = H_2S + 3H_2O$ until a certain definite temperature is reached, as $H_2S$ decomposes when the temperature is too high. Therefore it follows that all sulphide ore deposits were precipitated below the decomposing temperature of $H_2S$, at the pressure corresponding to the depth of the sulphides at the time of deposition. HIRAM W. HIXON.

Rome, Italy.

## Indicative Twine

THE EDITOR:

Sir—In a metallurgical examination I had recently to take a series of control samples in small canvas sacks. Under the circumstances sealing the sacks was out of the question. I provided myself, therefore, with a twine which was *indicative* and not obtainable in the vicinity in which the samples were taken. By using the well-known "clove hitch" or "builder's knot" and drawing up very tightly and securing with one tie, then cutting off the ends short, no sack could possibly be retied with its same piece of string. R. C. CANBY.

Wallingford, Conn.

# Consultation

## Import Duties on Metals

"Can you give me the present tariff rates on imports of ores, metals, and semi-manufactured metal products?"

In the year book of the American Bureau of Metal Statistics is a complete classification of imports of ores, metals, and metal products used for preparing statistics of imports. From this table the following data are taken:

| | Rate of Duty |
|---|---|
| **Copper Ores, Concentrates, and Matte:** | |
| Copper content | Free |
| **Copper, Crude, Refined, and Scrap:** | |
| Sundry | Free |
| **Copper Manufactures, Not Elsewhere Specified:** | |
| Composition metal, copper chief value, not specifically provided for | Free |
| Copper in rolls, sheets and rods, per pound | 2½c. |
| Copper tubes and tubing, seamless, per pound | 7c. |
| Copper tubes, brazed, per pound | 11c. |
| Copper wire | 25% |
| Other manufactures not specifically provided for | 40% |
| **Lead:** | |
| For smelting or refining in bond for export, ore concentrate or bullion, lead content | Free |
| Ores and matte, lead content, per pound | 1½c. |
| Bullion or base bullion, lead content, per pound | 2½c. |
| Pigs and bars, per pound | 2½c. |
| Old, reclaimed, scrap, and other forms except antimonial, lead content, per pound | 2½c. |
| Pipes, sheets, shot, glazers' lead, and wire, per pound | 2⅞c. |
| Other manufactures of n.s.p.f. | 40% |
| Type metal and antimonial lead, lead content, per pound | 2½c. |
| **Zinc:** | |
| Zinc ore for smelting or refining in bond for export, and zinc ores containing less than 10 per cent zinc, zinc content | Free |
| Zinc ores, zinc content, per pound. | |
| Containing 10 and less than 20 per cent zinc | ½c. |
| Containing 20 and less than 25 per cent zinc | 1c. |
| Containing 25 per cent or more zinc | 1½c. |
| Zinc, old and worn out, per pound | 1½c. |
| Zinc in blocks, pigs, or slabs, per pound | 1⅜c. |
| Zinc in sheets, per pound | 2c. |
| Zinc sheets plated, per pound | 2½c. |
| Zinc dust, per pound | 1⅜c |
| Other manufactures, n.s.p.f. | 40% |
| **Brass and Bronze:** | |
| Old brass and clippings manufactures of brass | Free |
| Brass rods, sheets, plates, bars, per pound | 4c. |
| Muntz or yellow metal sheets, sheathing, bolts, and other forms, per pound | 4c. |
| Brass tubes and tubing, seamless, per pound | 8c. |
| Brass wire | 25% |
| Table, household, kitchen, etc., n.s.p.f | 40% |
| **Manufactures of bronze:** | |
| Bronze wire | 25% |
| Bronze rods and sheets, per pound | 4c. |
| Other bronze manufactures, not plated, n.s.p.f. per pound | 40% |
| **Miscellaneous:** | |
| Aluminum, crude, scrap, and alloy, aluminum chief value, per pound | 5c |
| Aluminum plates, sheets, bars, and other forms, per pound | 9c. |
| Antimony ores and metal. | |
| Antimony ore | Free |
| Needle or liquated antimony, per pound | ¼c. |
| Regulus or metal, per pound | 2c. |
| Arsenic, metallic, per pound | 6c. |
| Arsenic sulphide (realgar and orpiment) | Free |
| Arsenious acid or white arsenic | Free |
| Bismuth | 7½% |
| Cadmium, per pound | 15c. |
| Cobalt ore | Free |
| Cobalt metal | Free |
| Nickel ore and matte | Free |
| Nickel and alloys, of which nickel is chief material in pigs, ingots, and other forms, per pound | 3c. |
| Platinum ore, nuggets, sponge, and scrap | Free |
| Platinum in ingots, bars, sheets, and plates not less than ¼ in. thick | Free |
| Manufactures wholly or chiefly of platinum except jewelry | 60% |
| Tin ore and oxide | Free |
| Tin in bars, blocks, pigs, and other forms | Free |
| Tin plate, terne plates, per pound | 1c. |
| Tin plate scrap | Free |

## Lubricating Hoist Brake Blocks

"Can you tell me what practice should be recommended for lubricating the brake blocks or brake linings of mine hoists? Should they be lubricated and what lubricant should be used?

"One master mechanic whose opinion I value highly stated that it meant a great deal to the life of brake blocks to keep them well lubricated and recommended high-grade steam-cylinder oil. I have talked with officials of other large mining companies who never heard of lubricating the blocks. I might add that one of these companies wears out the brake blocks and brake drums very rapidly."

The above inquiry was published in the *E. & M. J.* of Jan. 1, with an invitation to operators to record their experiences. The following is among the letters received:

"Brake blocks usually are of two types—wood blocks and asbestos blocks. We have very little knowledge of the effects of lubrication on wood blocks, but our experience with asbestos blocks leads us to advise against any lubrication whatever.

"Asbestos blocks contain necessarily some organic binding compound. This binding compound is of two general types: (a) rubber, or (b) bitumen mixed with other substances such as resins.

"The effect of lubricating oil on rubber is too well known to be mentioned in this connection. The effect of lubricating oil on the bituminous compounds is to make the blocks slip. The period of inefficiency will depend on the quantity of oil supplied. If oil is applied to the extent of producing a permanent film on which the blocks may ride, there will be practically no braking. When oil is added in quantity insufficient to produce a continuous film, braking efficiency is decreased for a short time, but as the oil thickens to a gum by accumulating dust or particles abraded from the drums or from the blocks themselves, the frictional efficiency rises rapidly and the blocks tend to grab.

"If grabbing brakes have any self-actuation or wrapping characteristics, they will lock.

"No one, as far as we know, advises applying oil to rubberized lining or blocks."

# News of the Week

## Summary

*BUREAU OF MINES proposed activities outlined by Director Turner—Oil shale committee appointed—Helium appropriation may exceed $1,000,000.*

*Installation of Bollen hoist at Park Utah mine—Spruce Mountain district, Nev., active—Fire destroys 50 dwellings in camp near Cananea, Mexico.*

*Duval-Texas Sulphur to install equipment for Frasch process—Freeport Texas Co. reports new sulphur dome in Texas.*

*Vieille Montagne issues statement regarding Idaho lead in zinc shipments—North Butte to sell bonds.*

*Sale of Julian Merger Mines, Inc., stock held illegal in California.*

*Mexican mining bureau issues instructions classifying regulations; golden spike for Southern Pacific in Mexico; highways under construction.*

*Hudson Bay iron ore to be tested—Minnesota fee owners must pay ore royalty tax—Mining geologists make good.*

*Mining Corporation ships high-grade ore from South Lorraine—Hammell to finance Harker Gold.*

*Oil pipe lines in United States total 90,000 miles—Ore discovery reported from Panama.*

*Lead deposits sought in Argentina; copper smelter closes, but mine continues.*

## Treadwell-Yukon Proves Sudbury Deposit

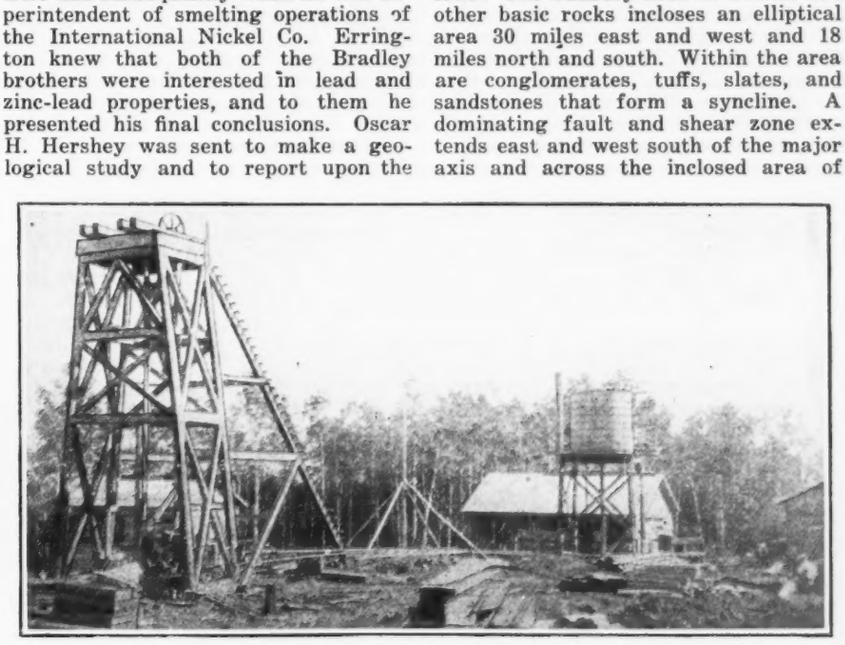
### Joseph Errington Interests, F. W. Bradley and Associates in New Property—Bunker Hill & Sullivan Have Half Interest

A NEW ZINC-LEAD DEPOSIT, probably of great importance, has been proved in the Sudbury district, Ontario, Canada, by exploratory borings undertaken by the Treadwell-Yukon Co., which is now successfully working a silver-lead property at Mayo, Y. T. The new deposit is 17 miles west of Sudbury, 2 miles south of the main line of the Canadian Pacific Railroad, and about 6 miles northwest of the Creighton mine, operated by the International Nickel Co.

The history of this important find is of interest. A sulphide outcrop in the immediate neighborhood and on the present property was known for many years. Joseph Errington, in behalf of Captain De Lamar and Colonel Thompson, sunk a shaft upon it and did some prospecting in 1902-3. However, both De Lamar and Thompson lost interest in the sulphide deposit because no nickel was associated with the sulphides. In addition, the sulphide deposit was not attractive at that time, as it was a complex mixture, the treatment of which promised to involve great difficulties and an uncertain outcome. Several years later a diamond-drill hole was put down about 600 ft. three miles to the east of the shaft first mentioned, and it cut sulphide ore similar to that first found. Errington obtained possession of the cores of this hole and noted that it presented the same characteristics of the orebody which he had partially explored. Having in mind the fact that complex zinc ores were being successfully treated by flotation, Errington sensed the importance of the exposures that had been made at two points separated by a three-mile interval. There were several intermediate exposures, and he became convinced that there was a long, substantial ore channel. With this idea foremost, he secured options extending several miles along the strike of the ore occurrences. Later when he showed the diamond drill cores to F. W. Bradley, the possibility of lead being associated with the zinc sulphides was advanced by Bradley and an analysis indicated the presence of lead in significant quantities.

Errington had been associated with Philip R. Bradley when the latter was investigating the Sudbury nickel district and subsequently when he was superintendent of smelting operations of the International Nickel Co. Errington knew that both of the Bradley brothers were interested in lead and zinc-lead properties, and to them he presented his final conclusions. Oscar H. Hershey was sent to make a geological study and to report upon the situation. As a result of his report, the Treadwell-Yukon Co. assumed Errington's options and in July, 1925, started a diamond-drilling program that occupied about a year. Eighty-eight holes, aggregating 45,000 ft., were drilled. This pioneer work confirmed earlier deductions and gave a clearer picture of the entire area. Additional options were acquired during the course of the drilling, and the present area now under option comprises 4,000 acres, covering the strike of a shear zone for 25,000 ft. After the completion of diamond drilling a site was selected and a 300-ft. vertical shaft was sunk. A crosscut was extended and an orebody 20 ft. in width was cut.

The geological conditions are as follows: The Sudbury area of norites and other basic rocks incloses an elliptical area 30 miles east and west and 18 miles north and south. Within the area are conglomerates, tuffs, slates, and sandstones that form a syncline. A dominating fault and shear zone extends east and west south of the major axis and across the inclosed area of



*Shaft and power house of Treadwell-Yukon Co., Sudbury, Ontario*

sedimentaries and metamorphic rocks. The shear zone dips 45 deg. to the south. The ore occurrences lie within the shear zone over 1,000 ft. in width. During the glacial period the elliptical area was occupied by a lake, which was subsequently drained by erosion cutting through the limits of the basin. The silt left by the lake masked most of the underlying rocks, but on one of the exposures the sulphide ore outcrop was found, as related in the historical outline given before.

Abundant evidence of the occurrence of a series of lenses of complex ore is now available. The ore varies in composition between wide limits. It contains zinc, lead, copper, silver, and gold. Present plans call for the extension of exploratory and development workings and the working out of the metallurgical problem. The presence of graphite in the ore promises to complicate the ore treatment. Methods for treating the ore are under experimental investigation. Upon their outcome depends the initiation of mining and milling. Mining operations now under way are in charge of G. M. Wiles.

The ownership of the options is held by the Treadwell-Yukon Co., which consists of one-half by the Bunker Hill & Sullivan Mining company and one-half by the Treadwell companies, divided into 30 per cent to the Alaska Treadwell, 10 per cent to the Alaska United, and 10 per cent to the Alaska Mexican. These companies are all under the management of F. W. Bradley and his brother, Philip R. Bradley. Joseph Errington is a director of the McIntyre Porcupine Mines, Ltd., and has been a pioneer in mining in eastern Canada since the early 90's.

## Spruce Mountain District Active

As the result of recent discoveries in the Black Forest, Spruce Consolidated, and other mines at Wells, Nev., the Spruce Mountain district, in Elko County, Nev., is the center of considerable activity. The Spruce Consolidated, recently taken over by the Nevada Zinc & Lead Co., under the direction of William Dunn, is being put in condition for large-scale production and exploration. The 8,000-ft. aërial tramway will be completed at once. This mine has produced 35,000 tons of silver-lead ore from workings none of which are more than 70-ft. below the surface.

A 65-ton lot of ore shipped from the Black Forest Mining & Smelting Co.'s new strike in the Dutch drift carried 53.67 oz. of silver to the ton, 34.8 per cent lead, and 17.85 per cent iron, and returned a net of $3.186.16.

Leasers are getting out ore in the property recently acqired by the Bullshead Consolidated Mining & Smelting Co.. while the company is running a main working adit to crosscut the major fissures of the formation. Across the canyon from the Bullshead tunnel. the O'Neill Consolidated Mining Co.. organized and directed by Stanley F. Kimball, is running a tunnel to crosscut the same fissures on the north side of the canyon. Camp buildings. and shops have been erected and machinery has been installed.

## Bollen Hoist Installed at Park Utah Mine

By Gail Martin

The Park Utah Consolidated Mines Co., Park City, Utah, has completed at its Park Utah mine the installation of the first Bollen pulley type of hoist to be made in America. The second one manufactured in America, much smaller in capacity than that at the Park Utah mine, is being operated by the Phelps Dodge Corporation. This hoist, manufactured by the Nordberg Manufacturing Co., licensees for foreign patentees, embodies radical departures in the technique of hoisting.

The Bollen type of hoist is chiefly valuable for the conservation of headroom space when used underground. It requires about one-quarter the space of an ordinary hoist. The Bollen hoist is merely a winding engine and sheave wheel mounted directly over the shaft. When using an 8-ft. sheave it will operate in a compartment 12 x 15 x 9 ft. high.

At the Park Utah the engine is placed 16 ft. above the top of the shaft. No more room is required for the operation of this hoist than is required by an ordinary 8-ft. sheave. Because it was convenient to install motors and other electrical equipment in one compartment, the hoist room at the Park Utah was made 20 x 25 x 9 ft. high in the center above sheave. On this type of hoist the sheave wheel automatically grips the cable. When ore is hoisted, the counterbalance with the man-cage is lowered. Lowering of the ore skip is accomplished by a reverse action.

Hoisting capacity and mobility are believed by Park Utah officials to be superior to other types. Operating costs are lower through the automatic features of the hoist. The capacity of the new Park Utah hoist is 500 tons per six hours, hoisting 4½ tons per trip. Speed is adjusted according to the depth of operation, being 400 ft. a minute for the 400-ft. depth. At a depth of 900 ft. this speed will be increased to 1,000 ft. a minute. Loading and unloading devices are of the standard skip and pocket type.

Safety devices of both electrical and mechanical types prevent overloading, overspeeding, and overwinding. A pneumatic buffer placed at the top of the shaft compartment will preclude injury to cage of skip if overwound. When running at full speed, the cage can be stopped in five seconds. Full speed can be attained in the same time. Operation is entirely automatic. No hoist-man is needed, since, like an automatic elevator in an apartment house, the hoist can be operated either on the cage or on any level.

The engine-driven pulley (8-ft. sheave) is installed at the center, parallel to the long diameter of the shaft, which has the manway in the center and the two hoisting compartments on the outside. The distance between the center of the two hoist compartments equals 8 ft., or exactly the diameter of the pulley.

The Bollen pulley is driven by direct-current motors geared to the sheave. Ward-Leonard control is used. The operating controls of the hoist are electric and can be placed at convenient points any distance from the hoist room or on the moving cage. The hoist room is gunite coated and hermetically sealed to exclude all dust. Blower ventilation has been provided to maintain the even temperature necessary for economical operation of the motors.

Installation of the Bollen type of hoist, used with much success in Belgium, France, and Poland, has been prompted by the development of large ore reserves in the Park Utah below the main or Ontario drainage tunnel level. The hoist will go into operation about Feb. 15, 1927.

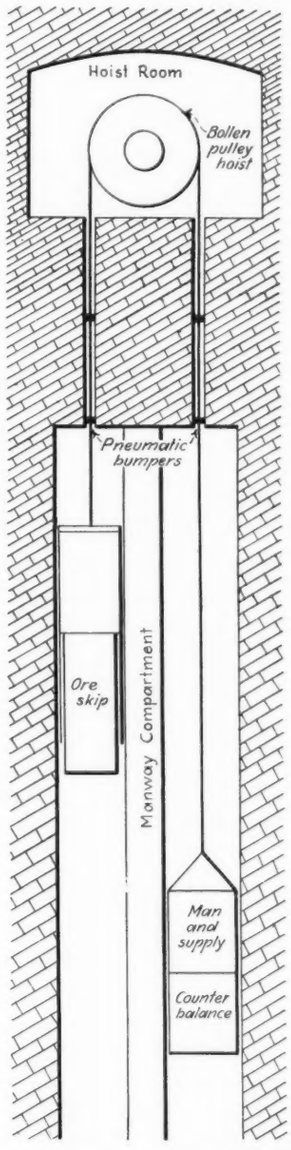



*Diagram showing method of installing Bollen pulley hoist at Park Utah mine*

## Wilson Leases Elsie K. Mine

Captain A. H. Wilson reports that he has given a lease and bond for $60,000 to Jensen and Purdy on the Elsie K., which Mr. Wilson owns, at Clarksfork, Idaho. The property has shipped 12 cars of ore that have netted Mr. Wilson approximately $4,000 to the car in silver and lead. The new owners expect to produce on a larger scale.

# News From Washington

By PAUL WOOTON
Special Correspondent

## Bureau of Mines Fares Better in Senate Committee Than in House; Turner Outlines Activities

THE Senate Appropriations Committee quickly restored to the Bureau of Mines the $30,040 which was cut out by the House Committee. The committee, however, was unable to act at this time on the additional increases of $155,500 asked by Senator Oddie, of Nevada. Those items will be the subject of early hearings before the Committee on Mines and Mining. It is hoped that they can be authorized in time to be included in the second deficiency bill.

At the hearings Senator Oddie expects to establish that the Bureau of Mines requested adequate funds to carry out the recommendations of the Reynders committee, but that the amount was reduced in the estimate's course to Congress until only $30,040 was left. He is anxious to establish the fact that it was not the Bureau which has denied to the mining industry the service which has long been furnished to agriculture and the manufacturing industries.

In explaining the purpose for which new money is being asked, Scott Turner, the director of the Bureau of Mines, in the course of his testimony before the Senate Appropriations Committee said in part:

"The plan for the expansion of this economic work to something more than production figures, which is what it amounts to now, originated with an advisory committee from the industry. The outstanding recommendation of that committee was that the element of business be considered.

"The plan as visualized by the advisory committee was much more comprehensive than is represented by the $30,000. We want to expand beyond production statistics. We want to furnish information regarding sales, distribution, consumption, and stocks. We thought we would make a start on copper and its allied metal, aluminum. The second group which we chose as being particularly typical and in need of this kind of service is comprised of lead and zinc. The world situation regarding these two metals has changed decidedly in the last ten years. Zinc ore reserves have been rising rapidly. The demand for zinc has been increasing and is overlapping what formerly was considered the lead field. The lead ore reserves and the world stocks of lead are not increasing as rapidly as are the world reserves of zinc ores. Producers of each of these metals would like to have a comprehensive survey of this trend."

The Bureau's helium appropriation also encountered difficulties. This item was not included in the regular budget. A supplemental estimate calls for $1,063,000. The House committee, which eliminated $30,040 for economic work on copper, lead, and zinc, in the interest of economy, voted the $1,063,000 without question. The sub-committee in the Senate struck out the helium item, but it was restored by the full committee, despite the fact that Senator Curtis, of Kansas, the majority floor leader, read a long statement to the committee purporting to show that private enterprise is ready to undertake the production of helium.

### Oil-Shale Committee Appointed

A technical advisory committee on oil shale, with Charles N. Bell, of Denver, as chairman, has been authorized by Director Turner of the Bureau of Mines. At a conference in Washington last week it was decided also to offer up to fifty barrels of oil recovered from shale to all responsible oil refineries for experimental purposes. In addition, the Navy has been asked to make a series of burning tests.

F. A. Dalburg, who is in charge of the mining operations which is supplying the shale for the plant, came to Washington with Mr. Bell for the conference. Senator Phipps, of Colorado, has been following the work at the plant closely and is endeavoring to secure an appropriation of $75,000 for the continuance of the plant's operation during the next fiscal year. Unless this money is voted by Congress the plant will have to be shut down June 30, the Bureau of the Budget having not seen fit to request further funds for the purpose.

### Vanadium in Colorado

Vanadium operations in Colorado, according to reports reaching the Bureau of Mines, indicate that the horizon which may be available there is larger than had been supposed until recently. This information is particularly gratifying to those responsible for war mineral supplies.

With the new $1,000,000 treatment plant of the United States Vanadium Co. in operation, there is assurance that an output of 100 tons a day can be maintained. Ore sufficient to supply the plant for six years has been blocked out, it is stated. Prospects in the same region are making favorable showings of possible commercial ore.

## Fire Destroys 50 Dwellings in Mining Camp

Fire of unknown origin recently destroyed more than 50 dwellings, occupied by mine laborers, in Buena Vista, two miles south of Cananea, Sonora, Mexico. Destruction of the entire village was averted only because no wind was blowing and the fire fighters were able to isolate the burning area. The camp is one of the nearby properties of the Cananea Consolidated Copper Co.

## California Mining Notes

Along the Mother Lode, the most significant recent change was the shutting down of the Carson Hill mine, late in December. This property has been in difficulties for several years, and in spite of efforts to develop new ore and to rehabilitate operations, results proved disappointing, and final shutdown was about the only alternative. The Moore mine, near Jackson, has suspended milling operations because of exhaustion of stopes on the 1,100 and 1,200 levels and the failure to discover new oreshoots. Gross production in November and December was about $27,200, the corresponding operating expense being $18,142. Development and other expenses were $17,800. In the two months 5,108 tons was milled. An oreshoot opened up on the 1,800 level was cut on the 1,500 level, but proved to be short and of low grade. A west crosscut is being extended on the 1,800 level and drifting is also under way. Shaft sinking below the 1,800 is to be resumed on Feb. 1, 1927.

At the Argonaut, sinking is under way, and new levels are to be opened up. The Kennedy has obtained good ore on its lowest level and is operating at normal capacity; and a new steel headframe is under construction. Central Eureka had one of its best years in 1926, and is now starting drifts on the 4,700 level. Milling operations are on the usual basis. Permanent pumps have been placed at the 500, 1,000, and 1,700 levels of the Old Eureka shaft, and exploration has been started on the 1,500 level. The Plymouth is reported to have some good ore, but operations are on a restricted basis.

Rumors are current that the old Keystone is to be reopened, and it is said that some work is to be done at the Pioneer, above Jackson. At West Point, in Calaveras County, a few small mines are in operation.

A mill is proposed for the Engineers mine, near Trona. This mine has made an excellent record. The Slate Range mine has been closed down. At Darwin, American Metals, Inc., is reported to have made an important discovery in its Independence mine. The Keeler road has been improved, and active mining and development is under way.

The Comanche Mining & Reduction Co. is reported to have cut a blind vein in its adit at Blind Spring Hill. A good showing of lead ore is also reported from the Reed Flat mine, out from Bishop. The property is being explored by the Mexican Mining Co.

Engels Copper Mining appears to be in more or less difficulty as a result of uncertain management policies.

At Grass Valley, the North Star is producing a good tonnage of ore of excellent grade. Major development in shaft sinking has been finished.

In northern California, the California Zinc discontinued operations about the middle of January, but resumed later in the month both at Winthrop and at Ingot. About 220 men are employed. Mason Valley Mines continues to operate the Balaklala and ship to Thompson. The Mountain Copper Co. is operating its pyrite deposit and making small shipments of copper ores at regular intervals.

## Mining in Alaska

The Riverside mill, at Hyder, has been shut down for the winter, but development is being pushed ahead on a promising body of ore with a view to having a sufficient reserve available to keep the mill in steady operation during the coming summer.

A petition is being signed in the Copper River district requesting the Alaska Road Commission to construct a road from McCarthy to Chisana via Scolai Pass to enable mining supplies to be moved to the headwaters of the White River, where considerable development is planned.

Arrangements are being made for the installation of a mill at the Mint-Ruby mine, at Susitna. The Moose Creek Mining Co. is arranging for the development and equipment of its property at Silver Dome, on the Susitna River. This is a recent discovery. The ore is complex. Average assays are reported as $7 in gold, $15 in silver, and appreciable quantities of zinc and molybdenum. The company's headquarters are at Chulitna, on the Alaska Railway.

At the annual meeting of the American Creek Gold Dredging Co., Fairbanks, it was stated that dredging operations would begin about Aug. 1, on American Creek, in the Hot Springs district. The company was organized and financed by business men of Fairbanks. Holdings comprise 5¼ miles of dredging ground of an average depth of 12½ ft. Assays show an average value of 95c. The property has been well tested, about sixty pits having been sunk to bedrock.

The Fairbanks Exploration Co. has been organized at Fairbanks, with an authorized capital of $300,000, to carry on hydraulic mining operations.

## Iron Ore Near Hudson Bay to Be Tested

According to information emanating from Canadian Government circles, Captain J. E. Bernier, who has commanded several trips to the Arctic for the government, will go into the Hudson Bay district this year with the expectation of taking the first step to found a steel and iron industry. According to the report, he has been commissioned by British steel makers to mine and bring out 500 tons of iron ore from the Nastapoka Islands, on the east side of the bay. He intends to take miners in with him and a string of barges to use as lighters between shore and ship. The ore will be taken directly to England and tested there.

## United Silver-Copper Reorganized

Prominent business men of Spokane have taken over the holdings of the United Silver-Copper Co., Chewelah, Stevens County, Wash., and have incorporated the Chewelah Union Mining Co. Conrad Wolfle was manager of this property for years, and it is said to have a production record of more than $2,000,000 in copper and silver, between 1910 and 1918. The incorporators are A. W. Lindsay, president of the Fidelity National Bank of Spokane; J. M. Fitzpatrick, and W. S. Gilbert.

## Duval-Texas Sulphur to Install Equipment

Complete equipment, including boilers, pumps, compressors, and other machinery, for the sulphur-mining plant which is to be installed at Palangana dome, San Diego, Tex., has been ordered by the Duval-Texas Sulphur Co. It is expected that the production of sulphur will be started early in May. The Frasch process will be used. At a recent meeting of the board of directors of the company held in Houston, Crain Belk was elected secretary-treasurer. Preliminary to beginning mining operations, thorough exploration of Palangana dome was made by means of test holes, and it was found that the sulphur deposit is of large area and great depth.

## Vieille Montagne Issues Statement Regarding Idaho Lead

As the result of an item which appeared in the *Engineering and Mining Journal* Feb. 5, there is published herewith a letter from one of the Belgian smelters:

"Gentlemen:

"Your attention is invited to an inaccurate article on page 253 in the current issue of the *Engineering and Mining Journal* with the caption

'Belgian Smelters Do Not Want Idaho Lead'

which refers to a supposed controversy between Vieille Montagne and the Highland Surprise Consolidated Mining Co.

"Your statement is decidedly incorrect, and I am afraid your correspondent sent idle gossip which a representative paper like yours certainly should have had verified before publication.

"The article implies we endeavored to repudiate a contract. Vieille Montagne is on record as *never* having repudiated any contract, and I ask that you give proper publicity to the inaccuracy and incorrectness of your article in order to eradicate the wrong impression you have created.

"Very truly yours,
"L. HIRSHLER,
"Consulting Engineer
"For S. A. De La Vieille Montagne."
"New York City, Feb. 4, 1927."

## Ruth-Hope Mines Report Progress

At the annual general meeting of Ruth-Hope Mines, which was held recently in Vancouver, B. C., J. Hanna, superintendent for the company, in the absence in England of R. H. Stewart, president and managing director, gave an account of the development that has been accomplished during the last year. He stated that in the north branch of the extension of the Silversmith vein high-grade lead-silver ore had been exposed over a length of 430 ft. On the south branch of the same vein a body of milling ore has been exposed for a length of 180 ft. and a shoot of good milling ore has been exposed for 100 ft. in the Stewart vein. A considerable tonnage of both shipping and milling ore has been exposed in the old Ruth mine. More than 1,200 tons of ore—some milling and some smelting—has been shipped to Trail during the year.

## Colorado Items

A new strike of silver-copper ore having an estimated value of about $100 per ton has been made on the S.A.K. lode group which is being operated by the Verde Mining Co., Westcliff, Colo. The ore streak is reported to be 18 in. wide, and has been opened up on two levels by drifts and crosscuts from the shaft on the vein. The Verde company is controlled by Ray Latson and associates, of Pueblo, and is making arrangements for some machinery with which to develop the property on a larger scale.

A train load, consisting of twelve cars of ore, was shipped from the property of the West Gold Mining Co., operating in the Idaho Springs, Colo., district, to the Golden Cycle mill, at Colorado City, Colo., recently. This renewed activity is a result of the find in the newly opened No. 2 stope. This stope is producing a considerable quantity of ore running from $5 to $8 a ton.

The Pocahontas and Humboldt properties, near Rosita, Colo.. have recently been leased to Henry Gamble and H. W. Hendershot, of Pueblo, Colo. John R. Smith, of Denver, is the owner of the mine. Mr. Gamble will be in charge of the mine and will sink the new shaft farther into the orebody and re-equip the mine during the next three months. The deal resulted from the finding of a new ore vein in virgin ground 300 ft. south of the old shaft. Both properties had been closed since 1887.

## North Butte to Sell $600,000 Bonds

Leasers from the "hill" properties of the North Butte Mining Co. are now shipping close to 4,000 tons per month, and it is expected that this will be increased to 7,500 tons early in the spring. The company is prospecting for zinc ores to the north, and as orebodies are encountered they will be turned over to leasers. In the last four months of last year, leasers shipped ore with net smelter return of about $155,000.

When the merger was formed there was authorized $1,500,000 7 per cent ten-year first-mortgage convertible bonds, these bonds being convertible at $8, $10, and $12.50 per share. However, $600,000 of these bonds soon will be offered at par, and purchasers of the bonds will receive a conversion warrant entitling the holder for a period of one year, beginning nine months from the date of purchase, to purchase stock of the company or to convert bonds into such stock at the rate of $4, $5, or $6 per share, according to order of purchase and tender for conversion.

## Sale of Julian Merger Mines, Inc., Stock Held Illegal in California

Following upon the action taken by the California Corporation Commissioner, ordering stock brokers to discontinue the sale of Western Lead stock on the ground that such transactions were unfair and unequitable to the public, Julian Merger Mines, Inc., was organized. The Corporation Commissioner of California held that the sale

of stock in Julian Merger mines was illegal unless and until a permit is obtained from the State Corporation Department. A suit was started based upon the arrest of H. B. Flesher, and on Jan. 28, 1927, the Second District Court of Appeal handed down a decision to the effect that the sale of Julian Merger Mines, Inc., stock is illegal until a permit is obtained.

Flesher contended through his attorneys that the mining corporation was organized under the laws of the District of Columbia and was therefore excluded from the provisions of the Corporate Securities Act of California. On the other hand, Deputy Attorney General Harrison contended that the Legislature of California intended to prevent the issuance of the securities, without a permit, of all domestic and foreign corporations whether organized in another state, a territory, or the District of Columbia. Flesher lost his suit, and the Appellate Court decision upheld Corporation Commissioner MacMillan, who banned the sale of the stock by the officers of the company, brokers, and individual dealers several months ago, as no permit had been granted. The commissioner made an investigation of the corporation.

## Minnesota Fee Owners Must Pay Royalty Tax

According to Judge E. J. Kenny, of the Duluth District Court, fee owners who lease iron-ore properties must pay the 6 per cent royalty tax imposed by the Minnesota State Legislature. The importance of the decision is realized from the fact that approximately $16,000,000 is paid annually in royalty under mining leases containing the same provision or similar covenants. This memorandum was attached to an order sustaining demurrers to complaints in three royalty tax cases heard last October. The three suits heard were: Belle M. Marble vs. Oliver Iron Mining Co. and Lorain Iron Mining Co.; Mississippi Land Co. vs. International Harvester Co.; and H. B. Fryberger vs. Inland Steel Co. The Mississippi Land Co. had the largest amount of money involved, $66,799 paid on royalties of $1,002,886 on the Hawkins mine, Nashwauk, Minn. The plaintiff demanded reimbursement of royalty tax payments, which request was refused, as the State Legislature passed the law to secure royalty tax and not a double tax on the operator. It is expected that appeals will be taken.

## New Canadian Mining Map

A map showing the relationship of the mining areas of central Canada to each other has been prepared by F. C. C. Lynch, of the Canadian Department of the Interior. It covers the territory extending eastward to Montreal, west as far as Portage la Prairie, Manitoba, and north to James Bay. Up to the present maps have been prepared largely on Provincial lines, and it has been difficult to obtain one showing the relative positions of the principal mining fields. This need has now been supplied, and the map can be obtained on application to the Department of the Interior at Ottawa.

# Toronto Letter

*By Our Special Correspondent for Northern Ontario*

## Mining Corporation Ships High-Grade Ore from South Lorrain

The Mining Corporation of Canada has made its first shipment of high-grade ore for 1927 from its South Lorrain properties. The shipment consisted of 62 tons with an average assay of 6,350 oz. per ton. This probably represents the greatest number of ounces in any single shipment ever sampled in Cobalt. Some of the ore was so rich that it had to be heated by torches before it could be broken with hammers. Other shipments have been made from the Cobalt district which were considerably richer, but consisted of a smaller quantity. The record is probably held by the shipment from the Foster lease, which consisted of 9.3 tons of ore for which the producers received approximately $100,000.

Within a few days the Lake Shore mill, in Kirkland, will be regularly treating 700 tons a day, and contrary to expectations there is no indication that there will be a decrease in grade. It is expected that production will be at the rate of over $300,000 a month. The main shaft has reached a depth of 1,300 ft. and a station has been established at 1,200 ft. A new crusher station and loading pockets will be installed below the 1,400 level and the shaft will then be continued to 1,600 ft.

The shaft at the Barry-Hollinger mine has reached a depth of 1,000 ft., and development work has been started at that level. A new electric hoist has been installed, and it is expected that when ore starts coming from the 1,000 level the mill will handle 150 tons a day.

### Harker Gold Financing

J. E. Hammell has announced that he is arranging to finance the Harker Gold Mines, of which he is the president. The company is capitalized at 5,000,000 shares of $1 par, 2,500,000 of which have been issued. It is understood that the original shareholders will return 1,000,000 shares to the Treasury and that this stock will be offered to the public. Only a small part of the property has been developed, and engineers report that it holds out substantial possibilities. In view of the success that Hammell met in the financing of the Howey Gold Mines, it is believed that he will have little difficulty in financing the Harker.

It is stated that a further dividend of $2 per unit will be paid to unit holders of the Howey Red Lake Syndicate. A dividend of $7 a unit was paid last spring, following the option payment made by the Dome Mines of Porcupine, and the further distribution will be made from money derived from the same source. There are 5,000 units outstanding, and the syndicate controls the Howey Gold Mines.

### Mining Geologists Make Good

The larger, well-managed mining companies are generally a training ground for many young engineers, who not only have the possibility of advancement with the company for which they are working, but who also find opportunities when other companies need the services of men trained in sound organizations. It must therefore be considered a compliment to the management of the Dome Mines, Porcupine, when within a short time three members of the staff should be offered important posts. D. G. H. Wright, chief geologist, recently left to accept the position as geologist for the Howey Gold Mines and other properties in which J. E. Hammell is interested. A. W. Carlyle, who was Mr. Wright's assistant, has been appointed one of Dr. Bancroft's assistants in a geological survey of a big concession in Rhodesia. He is taking five young Canadian geologists with him, and it is estimated that the survey will take two years. It is also understood that C. W. Dowsett, general superintendent of the Dome, has been offered and will probably accept the management of an important African copper property.

## New Sulphur Dome in Texas

Drilling by Freeport Texas Co. on the Allen dome, leased from the Roxana Petroleum Co., indicates a large sulphur deposit and the probability of favorable operating conditions.

The dome is about 600 acres in extent, and though officials of the company are reticent about discussing the acquisition it seems probable that it contains an important sulphur reserve which can be easily developed when conditions warrant. An important factor is its nearness to a river, which assures the large supply of water necessary to work a sulphur deposit by the Frasch method. The Allen dome is only about 10 miles from Freeport, so that shipping costs would be low.

Development of this mound will presumably be some time in the future. No immediate change in Freeport's operations are to be expected. It is exceedingly important, however, in that it gives Freeport control over three of the largest sulphur deposits in the country. Freeport's acquisition of the Roxana mound indicates that a third company will be prevented from entering the field in competition.

Freeport's production is now running at about the best rate on record. A total of between 580,000 and 600,000 tons was produced in the fiscal year ended Nov. 30, 1926, and net earnings after depreciation and depletion will probably be about $2.25 a share.

## Comstock Silver Shipping 15 Cars Per Week

The Comstock Silver Mining Co. has recently had its property at Stockton Hill, 12 miles north of Kingman, Ariz., examined by H. C. Wilmot, consulting engineer. The company has done considerable exploration work during the last year and has been shipping lead-silver-zinc ore to smelters at the rate of 15 cars per week. All the work so far has been done in tunnels near the surface, but if recommendations of the examining engineer are followed exploration at greater depth will be attempted. The president of the company is F. W. Manson, who operates the Kingman sampling plant.

# Mexico City Letter

By W. L. Vail
*Special Correspondent*

## Mexican Bureau Issues Instructions Clarifying Regulations

**Mexico City, Jan. 31**—In answer to complaints made to the Mexican Bureau of Mines regarding irregularities in the issue of new mining concessions by local agencies, the Bureau has issued special instructions to the agents in accord with the new mining law and regulations.

In the future, the deposit which is required when a petition for a mining concession is filed will be returned after the deduction of fixed charges if the petition is not admitted. In the past there has been some delay in returning the deposit, and numerous complaints have been filed with the Mining Bureau in this city. The Bureau admits that there have been many complaints made against local agents in the interior, but holds that a majority of them have been found, on investigation, not well substantiated. The new ruling has been made, however, to avoid any possibility of irregularities.

It is also given out officially that the requirements of the new mining law to perform a minimum amount of work, graded on the extent of the claims, do not apply to mining properties titled prior to the operation of the present laws. They will pay, according to the number of claims, a graduated taxation, but are relieved from the obligation to do a minimum amount of work. The decision is interesting for the reason that the provision was vague and has led to many requests for an authoritative statement on the points at issue.

Reports from Chihuahua state that a syndicate organized in Los Angeles, Calif., headed by Harry Chandler, owner of the *Los Angeles Times*, has taken a contract for unwatering the Jesus Maria mines, of that state, and proceeding with their development if results justify. The Jesus Maria was one of the paying gold mines of Mexico, thirty years ago, under the management of Corrigan & McKinney, of Cleveland, Ohio. For many years the property has been completely abandoned.

The Cusi-Mexicana Mining Co., of the same state, is reported to have discovered recently some valuable new orebodies. H. C. Dudley, of Duluth, Minn., is president of the company. He is also vice-president of the Ahumada Lead Co. in the same district. Russell H. Bennett, of Minneapolis, is vice-president of the Cusi-Mexicana.

### Guerrero Activities

The R. N. Watson interests, at Teotepec, Guerrero, are developing ore with the intention of erecting a flotation plant. These properties are in the Sierra Madres and are tributary to Acapulco. Japanese capital has acquired considerable property near San Nicolas del Oro and is doing extensive development and shipping some ore. The old smelter at Campo Morado has been closed down on account of a radical change in ores which has necessitated the erection of an experimental plant of 200 tons' capacity. The American Metals Co., through its subsidiary, the Peñoles Mining Co., which took over the Suriana from the Devereaux interests, in New York, some time ago, is installing a large plant for the treatment of ores, which will probably be completed toward the end of this year. Development results up to date have proved entirely satisfactory. Work has started on the construction of an automobile road from the Balsas bridge to the Campo Morado region, to be used later for a standard-gage railway. The new road will extend down the Balsas canyon to Zihuateneco, a port on the Pacific coast, and thence to Acapulco. Plans for this railway were finished and accepted by the Mexican Government some years ago and the bonds for construction were guaranteed by the Lewisohns, of New York, lessees of the Campo Morado; but work was held up because of the continuous revolutions.

### Zacatecas Notes

The new Peñoles smelter is expected to open for business in March. The International Mining Co. is busily engaged in extracting ores from the Santana for the new smelter. According to report the Linares Mining Co., a subsidiary of the St. Joseph Lead Co., has withdrawn from active operations in the Zacatecas district. El Bote expects to start unwatering the mines next month. In the meantime the company is actively engaged in milling the old dumps.

### Golden Spike for S. P. in Mexico

The golden spike which will be used for the formal opening of the Southern Pacific Railway of Mexico, at the end of March, is now being made in Guadalajara, from the product of the Purisima Mining Co., Zapatan, territory of Nayarit. The Purisima mines produce gold and silver. Completion of the Southern Pacific made the working of these properties, only three hours' distant from the new line, possible. The manager is W. L. Ireland.

Reports from the Natividad mines state that recent experiments with the cyanide process on the low-grade ores, which are abundant on the property, have been very successful. Results have encouraged the management to increase heavily the development work and extraction.

### Industrial Congress, March 15

Mining interests throughout Mexico will be generally represented at the Third National Industrial Congress, which is scheduled to meet in Monterey on March 15. Among other themes to be discussed of interest to miners is the varying conditions of production in different sections of the country, labor legislation in regard to the mining industry, and a revision of some of the existent laws which it is claimed retard the full development of large properties.

### Highways Under Construction

Much increase in mining development throughout the interior of Mexico is anticipated this year as a direct result of the government's plan to spend a minimum of 800,000 pesos a month on new automobile highways. Apart from several trunk lines, the government plans to construct innumerable laterals which will connect well-known mining sections not now opened up because of lack of communication. In addition several of the state governments have expressed a willingness to work with private mining companies for the purpose of forwarding the good-roads campaign. In some instances, propositions have already been made to mining companies to construct the necessary roads, advancing the funds and accepting repayment in a reduction of taxes, over a period of years.

### Notes from Oaxaca

At Oaxaca the Peñoles company is milling about 125 tons daily at the Natividad. The American Smelting & Refining Co. continues work of unwatering the old San Juan shaft at Taviche, and is also doing considerable sampling of other adjacent properties with the view of finding sufficient milling ore to warrant the erection of a mill. It is claimed that there is now sufficient ore on the San Juan dump to cover the original cost of the mine, purchased about one year ago. The Majestic Mining Co., of Kansas City, has started its 50-ton pneumatic flotation plant, in the Totoloapam district, southeast of the city of Oaxaca, and is producing a ton and a half of concentrates daily. The Dudleys have also opened up a 50-ton reduction plant, 35 miles southeast of Oaxaca.

C. R. Riley, superintendent of mines for the San Rafael y Anexas Pachuca, has returned from a six months' vacation in California. The San Pedro Analco, Jalisco, controlled by the San Rafael and Anexas, report 336 cubic meters explored, 75,318 tons treated, and 31,088 kilos of silver shipped during the last three months of 1926. While the mill has been temporarily closed, the mine continues in operation.

## San Jose de Gracia Mines Resume Operations

The Chandis Securities Co., of Los Angeles, has taken over the Jesus Maria y Anexas mining properties, at San Jose de Gracia, Sinaloa, Mexico, and started full operations on Feb. 1. These properties produced more than $20,000,000 since their discovery in 1828 to the close of 1917. They have been worked to a depth of only 750 ft. The Mexican Government under President Carranza worked the mines for three years, 1914 to 1917. H. B. Bradley is local manager for the Chandis company.

## Simon Silver-Lead Closes Mill

The Simon Silver-Lead Mines Co., operating 25 miles from Mina, Nev., in the face of recent optimistic reports which have been current in newspapers throughout the state, has closed its 250-ton concentrating plant. Most of the men employed underground have been released, but it is understood that a small crew will be retained on important development work that has already been started.

# London Letter

By W. A. Doman

*Special Correspondent*

## Mount Isa Recipient of Outside Funds—Ore Discovery Reported from Panama

London, Jan. 25—On previous occasions I have mentioned the Mount Isa silver-lead properties, in Queensland, in which the Anglo-American Corporation of South Africa has taken an interest. Prospects appear hopeful, and some of the Corporation's engineers are now on the way to investigate. Carl R. Davis, the consulting engineer in South Africa, has also left to join the party. Hitherto only the Anglo-American Corporation has been mentioned in connection with the Mount Isa, but I understand that A. Chester Beatty, of the Selection Trust, and either Leslie Urquhart or the Russo-Asiatic Corporation are also interested. When such powerful corporations put their funds into an undertaking, speculators are not slow to follow the hint, and this probably explains the sharp rise in the price of the shares, for they have jumped from about 18s. to 36s. The immediate future seems to be discounted, but if reports are confirmed the price will go still higher.

Since referring to the Panama Corporation last week I have heard indirectly that encouraging discoveries have been made on the Veraguas concession. In one place 6 dwt. gold, 14 per cent zinc, and 25 per cent lead are reported, and the views of those who formed the company and put the shares on the market are rising. It is argued that on such an extensive property additional finds must be made.

### Lost Choaco Mine Reported Found

An interesting piece of news comes from the Chioco district on the Zambesia Mining Development Corporation. It appears that in the sixteenth century some monks discovered, and had worked, a silver mine called the Choaco. For centuries this property was lost and covered in bush. Toward the end of last year, I understand, a prospector came across this mine, and before making any announcement did a good deal of fossicking. He is now convinced that it is the old Choaco. Samples taken from the surface were sent to an assayer at Salisbury, and fourteen of them have assayed traces of gold, from ½ oz. to 10 oz. of silver, from 5 per cent to 25 per cent lead, 9.46 per cent zinc, and 1.14 per cent copper. A further cable states that more discoveries have been made. It is hoped to hold a meeting of the company early in March, when full particulars will be given out.

### Tin Development

In referring last week to the proposed South West Africa Tin Corporation, I half suggested that the Ranga Tin Syndicate's properties were outside this company. I now understand that they will be included, and that something like eight shares in the new venture will be given for each share in the Ranga Syndicate.

The Keffi Consolidated Tin Co., in Nigeria bids fair to become an important producer. Last year the output was 1,170 tons, against 1,036 tons for 1925, and with the object of still further increasing production the large Bucyrus steam shovel operating on the Bukuru mine is being duplicated. A small Bucyrus steam excavator has also been purchased, to be used in connection with the shovel plant. The machinery has reached Nigeria, and it is expected to be in running order in March. The Dorowa River deposit is opening up in excess of expectations, and Allan A. Davidson, the company's superintendent-engineer, cables that the obvious reserves are at least 16,000 tons, and 80 per cent of the company's areas is still to be prospected.

## U. S. Has 90,000 Miles of Oil Pipe Lines

A survey of petroleum pipe lines recently conducted by the U. S. Bureau of Mines shows a total of slightly more than 90,000 miles of pipe lines in the United States on May 1, 1926, an increase of 7,000 miles in two years. This tremendous pipe-line system has a capacity of approximately 15,750,000 bbl. of crude oil, which is equivalent to one-fourth of the nation's average production for one month.

Oklahoma, with 19,180 miles of pipe lines, is the leading state in total mileage, with Texas second and Pennsylvania third. From point of trunk lines alone Texas is considerably ahead of any of the other states, a position which it owes to its size and to the growth in the movement to its Gulf ports. California, though the leading state from point of production, ranks only seventh in pipe-line mileage. This is due to the fortunate location of the Los Angeles Basin fields, some of which are within sight of the refineries to which their oil is delivered or of the port of San Pedro, through which their oil is shipped.

Pipe lines varied in diameter from 2 to 16 in., the most common size being 6 in. The total pipe-line mileage was about equally divided between trunk lines and gathering lines, though the capacity of the former was about four times that of the latter. This was due, of course, to the difference in average diameter, that for the former being 7.4 in., as compared with 3.7 in. for the last named. The common size for trunk lines was 8 in., and for gathering lines 2 in.

## Alaska Juneau in December

In December, 1926, Alaska Juneau mined and trammed to mill 368,900 tons. Total recovery was $221,000, or 59.91c. per ton; expenditures were $187,250, or 50.76c. per ton; and operating profit was $33,750, or 9.15c. per ton. Other expenditures and accrued charges were $20,000, leaving a surplus of $13,750 for the month.

Late November a "shot" of 10½ tons of explosives brought down an estimated total of 3,000,000 tons of rock. For some time past car samples have been taken at the tipples, the results of assays from these samples indicating the approximate gold content of the rock sent to the mills.

# Buenos Aires Letter

*By Our Special Correspondent*

## Prospectors Seeking Lead Deposits—Copper Smelter Shuts Down, But Mine Continues

Buenos Aires, Jan. 12—There is at present a decided revival of mining activity in Argentina, more especially in the northwestern provinces of La Rioja, Jujuy, and Salta. Much exploration for lead is being done in that section, practically all of it by local capital and native prospectors. Many interesting discoveries of lead ore are reported, particularly in La Rioja, but in every case far from the state railways and often at extreme altitudes. With railway shipping stations more than a thousand miles to the nearest seaport, freight rates are excessively high, and with an additional hundred-mile haul over poor roads, often nothing more than wide trails, marketing costs of the ore are high, and will remain so until lead-smelting facilities can be established adjacent to these properties. Almost without exception lead ores so far found are so low in silver that the resulting bullion would hardly pay costs of refining to recover the silver. Gold values are extremely low.

Blister copper bars with high values in gold and silver are being produced by the Corporation Minera de Famatima, Santa Florentina, Chilecito, La Rioja, which has again resumed operations, this time under government supervision. The financing in this instance was accomplished through credits granted by Banco de la Nacion. The technical staff is all from the United States, the consulting engineer being Bancroft Gore, with Carleton C. Semple, manager of mines; Theodore L. Johnson, superintendent of mill and smelter; and Edward E. Hyde, chief chemist. This property has been through many vicisitudes and difficulties. The present financial assistance by the bank is considered an effort on the part of the authorities to start a real permanent mining revival that will make this country an important producer of ores and metallic products. An electrolytic refinery is contemplated, also under government subsidy, so that refined copper may be among the increasing number of products classified under the trade mark of "Industria Argentina."

The blister now being produced is shipped by fast passenger steamers from Buenos Aires to New York, where it is refined. Custom-house declarations indicate exceptional values of gold in this blister, ranging from 400 to 600 grams per metric ton.

It is reported from the smelter at Chilecito that the unusual lack of rainfall and melting snow on the adjacent Andean summits has so reduced the quantity of hydro-electric energy needed to operate the plant that operations were ordered suspended by the government authorities until the coming of heavy rains, long overdue in that section. It is understood that developments at the mine will proceed as usual during the temporary shutdown of the smelter.

# Societies, Addresses, and Reports

## Phelps Dodge Honors Those Connected With Construction of New Smelter Units

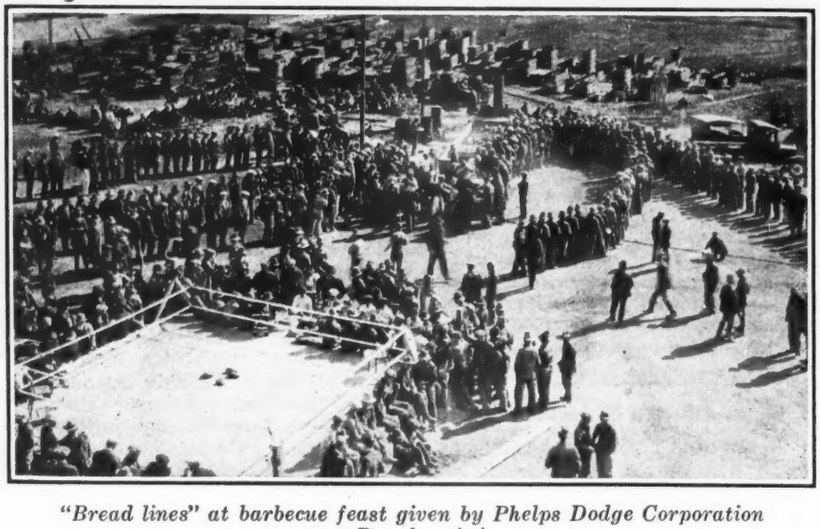
Following the banquet on Wednesday evening, Jan. 5, 1927, at Douglas, Ariz., to those of the Copper Queen staff, the Dwight P. Robinson Co. staff, and others intimately connected with the design and construction of the new smelting units, the Phelps Dodge management gave a barbecue to all the employees on the plant, whether on operating or construction work, on Friday, Jan. 14. For two hours about 1,000 men were entertained by a fast boxing card, music by the preparation department orchestra, and an inexhaustible supply of barbecued beef, pork, and accessories, prepared by W. M. McDonald and his crew—past masters in the art.

The new plant consists of two reverberatory furnaces with twelve eleven-hearth roasters superimposed. The design provides for the transmission of calcines from the roasters to the furnaces in an air- and heat-insulated system, eliminating the heat and dust losses and tramming expense incident to the usual method. It was just nine months and four days from the time the first concrete was poured until the first matte was tapped from the new plant.

## Explosives Convention Discusses Blasting Methods

Important questions in regard to railroad and road-building work, contracting, quarrying, coal and metal mining, and special uses of explosives were discussed at the technical explosives convention of the du Pont company held in Wilmington, Del., Jan. 25, 26 and 27. The convention was attended by representatives of the technical force at the home office and in the field, by officials of the administration, chemical, sales, and manufacturing forces. There were also present men from Nobel Industries, Ltd., of England, the Canadian Explosives, Ltd., of Montreal, and the Canadian Giant, Ltd., of Vancouver, Canada.

Papers were read on high-speed tunneling methods now being used at the Great Northern tunnel, Scenic, Wash.; the practices employed in muskeg blasting for road construction, limitations of the well-drill method of blasting, how to handle misfires, and a review of unusual blasting conditions.



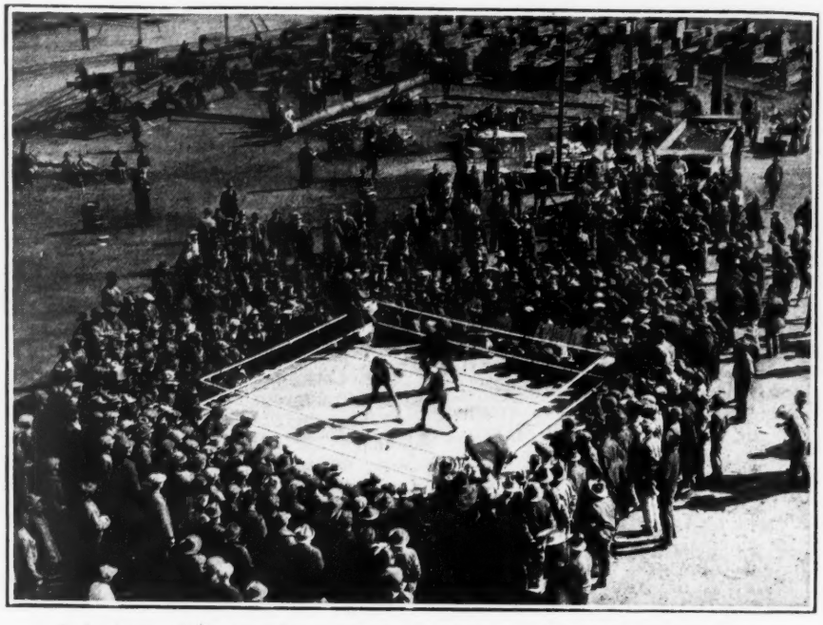
*"Bread lines" at barbecue feast given by Phelps Dodge Corporation at Douglas, Ariz.*

## San Francisco Section A.I.M.E. Elects Officers

Wilbur H. Grant has been elected chairman of the San Francisco section of the A.I.M.E. The other officers of the section are C. G. Maier, secretary; J. F. Mitchell-Roberts, vice-chairman, and Charles Monroe and H. T. Hamilton, members of the executive committee.

## Research Work Planned for Michigan

A definite program of research, designed to aid in the location of new copper and iron deposits and development of methods for the treatment of low grades, will be planned by the Copper and Iron Research committees of upper Michigan. An appropriation of $50,000 per year is expected from the State of Michigan for this purpose. The project has the support of the state administration, which recognizes the importance of the work.



*A feature of the two-hour entertainment provided at Douglas, Ariz., upon completion of new reverberatories*

## Phoenix Chapter A.I.M.E. Would Erect Statue to Greenway

The Phoenix chapter of the A.I.M.E. at a recent meeting approved a bill that has been introduced into the Legislature of the State of Arizona, to appropriate funds for the erection of a memorial statue in the national Hall of Fame at Washington, D. C., to the memory of the late General John C. Greenway.

## Engineers Hold Meeting in Toronto

The annual meeting of the Association of Professional Engineers of Ontario was held in Toronto, Ont., on Jan. 25. The principal subject of discussion was the necessity of amending numerous acts of the Legislature which govern the operations of the profession. It was pointed out that there are twelve such acts, which define the classes of work on which professional engineers must be employed. As there are several branches of the professsion, it was suggested that amendments should be asked for specifying the kind of engineer required.

# People You Should Know About

**Dr. Otto Sussman** has gone to Cuba to visit the Matahambre mine.

**John L. Magney**, mining and metallurgical engineer, of Spokane, Wash., is in New York.

**W. Lee Heidenreich** has gone to Cobalt, and from there expects shortly to go to Rouyn, Quebec.

**John D. Cuddihy**, of Calumet, Mich., president of the Hancock Consolidated Mining Co., has left on a three months' trip to South America.

**Andrew Meyer** left New York on Feb. 2 for Colombia, South America, where he has accepted a position with the Cia. Minera Choco Pacifico at Andagoya.

**Newton W. Emmens**, mining engineer of Vancouver, B. C., has been elected to the Council of the British Columbia Chamber of Mines for 1927.

**M. W. Woolley**, manager of the ore-purchasing department of the United States Smelting, Refining & Mining Co., is making a trip through Nevada and California.

**Stanley N. Graham** has been appointed the Anglo-French Exploration Co.'s correspondent in Canada, in place of **J. B. Tyrrell**, whose agreement terminated Dec. 31, 1926.

**Dr. H. Lotz**, an eminent German geologist and diamond expert, recently visited Barkly West, near Kimberley, South Africa. He expects to return to Germany in March next.

**Dr. L. D. Ricketts**, accompanied by a party of Los Angeles capitalists, recently visited Bisbee in Dr. Ricketts' private car. The objective of the trip was an inspection of the mining properties at Cananea, Mexico.

**C. M. Eye**, mining engineer of San Francisco, has been visiting the northern Luzon gold districts of the Philippine Islands, and left Manila in company with **James Colbath** in January en route to San Francisco. Mr. Eye was due to arrive in San Francisco on Feb. 10.

**William H. Hax**, of New York and Scranton, Pa., after spending about a month in Montana making preliminary plans for the starting of the 15,000-ft. tunnel of the Basin Montana Tunnel Co., two miles east of Basin, left for the East. Mr. Hax is president of the company.

**Dr. Edward Payson Mathewson**, professor of administration of mining industries at the University of Arizona, has been appointed one of two advisors to Dr. Byron Cummings, acting president of the university. Dr. Mathewson, who is now a resident of Tucson, Ariz., is on a visit to Montreal.

**Bancroft Gore**, of the department of metallurgy, South Dakota State School of Mines, Rapid City, S. D., returned last week from Buenos Aires, where he had been engaged by the Argentine Government on a survey of the copper- and lead-mining opportunities of the Province of La Rioja.

**Frank L. Bosqui** has been appointed chief metallurgist on the staff of the Anglo-American Corporation and is now on his way to Queensland, Australia, to take up the metallurgical questions and design equipment for the Mount Isa Mines, Ltd., whose large silver-lead ore deposit was recently acquired by that corporation.

**Willet Green Miller**, first Provincial Geologist of Ontario, was accorded a marked posthumous honor recently, when a commemorative memorial plaque recording his achievements was unveiled at Cobalt, Ontario, under the auspices of the Hon. Charles McCrea, Minister of Mines for Ontario. Dr. Miller had been Provincial Geologist of the Province of Ontario from 1902 to

WILLET GREEN MILLER
FIRST PROVINCIAL GEOLOGIST OF ONTARIO
1863-1925
TO COBALT HE GAVE ITS NAME
AND A PLACE AMONG THE GREAT MINING
CAMPS OF THE WORLD
HE READ THE SECRET OF THE ROCKS
AND OPENED THE PORTAL FOR THE OUTPOURING
OF THEIR WONDERFUL RICHES
HIS MONUMENT IS
NEW ONTARIO

*The Miller memorial plaque*

1925. In concluding his address at the unveiling ceremonies, Mr. McCrea said of Dr. Miller (as immortalized on the plaque): "It is now my duty and privilege to unveil this memorial to Willet Green Miller, . . . who gave Cobalt its name and a place among the great mining camps of the world, who read the secret of the rocks and opened the portal for the outpouring of their wonderful riches. His monument is *New Ontario*." The plaque is the work of Mrs. Dorothy Dick, an English artist. It is here reproduced through the courtesy of C. W. Knight, of Cobalt.

**Dr. Waldemar Lindgren**, head of the mining course at M. I. T., recently addressed the mining students of that institution and told them about the apex litigation and the Carson suits which closely followed each other while Dr. Lindgren was in Butte. He stated, "It was said that in October it was impossible to throw a rock in the Finlen Hotel without hitting a lawyer or an engineer."

**Harold Titcombe** and **Richard Tippert** have left London for Australia, where they are to be joined by **Carl Davis**, consulting engineer, of South Africa, to report on the Mount Isa Co.'s mines, Queensland, for the Anglo-American Corporation of South Africa, which holds an option to take up 550,000 £1 shares at par in the Mount Isa company.

**Walter A. RuKeyser**, consulting mining engineer of New York City, has recently made several trips into the Rouyn district of Quebec, where he is consulting engineer for the Montreal Rouyn Mines, Ltd., and other properties. He has also recently completed an examination for William Lyall and associates, of Montreal, also in Quebec, and an examination of the properties of the Extension Mining Co., Ltd., at Cobalt, Ont. Mr. RuKeyser sailed for England at the end of January on professional business. He will return approximately March 15, after which date he will return to Canada to direct the further development of the properties for which he is consulting engineer.

## Obituary

**Viscount Bearsted**, who is reputed to have exercised a greater influence in the development of the oil fields of the East than any other man, died recently in London.

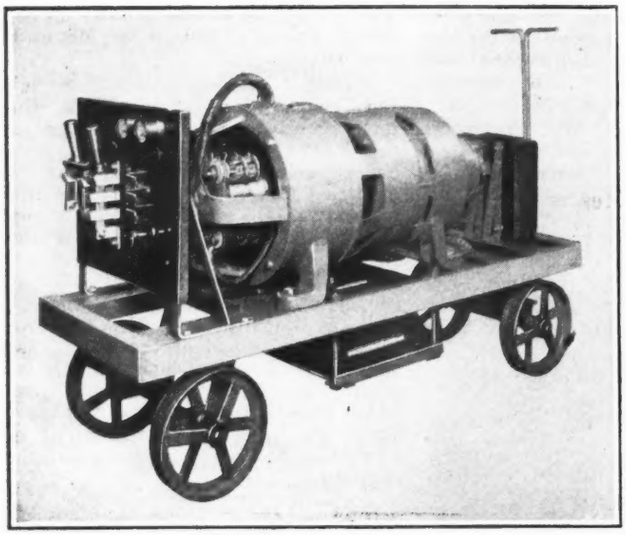
**Frank D. Wheeler**, who was born in Wisconsin and lived some years in Michigan, died on Dec. 18, at the age of seventy-one, in a Johannesburg nursing home. He went to South Africa, in 1893, as a diamond driller. He was later interested in mining in Rhodesia, in the Great Belingwe mine. He was a director of the African Iron & Steel Products, Ltd.

**Dr. Henry Augustus Whiting**, eighty-one years old, formerly a mining engineer, died suddenly at his home in Baltimore on Jan. 31. He was a graduate of Columbia University and Columbia School of Mines. After practicing for many years his sight began to fail and he studied medicine, specializing in neuropathy. Later he became totally blind but continued to practice.

**John Porterie**, mining engineer, the son of J. A. Porterie, assayer and mining engineer of Phoenix, died from injuries received in a blast at the United Verde Copper Co.'s mine at Jerome, Jan. 17. He was twenty-four years old. Both Mr. Porterie and his father are well known in Arizona, his father having followed the mining profession for many years, the son being an engineer on the staff of the United Verde Copper Co.

**Prof. Charles C. Nutting**, oldest member, in point of service, of the faculty of the University of Iowa, and known for his geological research in Alaska, the Bahamas, the Fiji Islands, New Zealand and Trinidad, died at Iowa City on Jan. 25. He was sixty-eight years old. Professor Nutting was born in Jacksonville, Ill., and was educated at Blackburn University, receiving his degrees in 1880 and 1882. After his graduation from Blackburn Professor Nutting engaged in scientific exploration in Central America for the Smithsonian Institution. He wrote several books describing his explorations, and many scientific papers also.

# New Machinery and Inventions



*This 300-amp. a.c. welding machine has only two castings, weighing in all 15 lb. All else has been replaced by welded steel.*

## Welding Used in Making Welding Machine

Among the developments in the machinery-building field is the substitution of welded structural steel in place of gray-iron castings. This is illustrated in the new 300-amp. a.c. welding machine of the Lincoln Electric Co., of Cleveland, Ohio. This outfit has only two gray-iron castings, weighing about 15 lb. in all, which have not been replaced with welded-steel construction. Other sizes and types of welders are being changed over to the steel construction as rapidly as possible. The motor and generator end rings, brackets, and connecting rings are all made of structural angles rolled up into the proper shape and welded together. The feet of the motor generator set are made of drop forgings. Truck wheels are made of T-sections rolled on a special machine. The hub of the wheel is made of steel tube. Control panels are usually made of slate or special nonmetallic compounds, but the panel illustrated is made of sheet steel welded together and welded to the supports.

## New Single Reduction Gear Units

A series of reduction gear units for heavy service has been developed by R. D. Nuttall Co., Pittsburgh, Pa. There are six units in the series, which covers a range of from 150 to 2,000 hp. They are designed for services that require transmitting heavy loads at relatively high speeds, such as main and auxiliary drives in steel mills, the driving of crushers, hoists, pumps, and other similar heavy equipment.

The units are equipped with either the company's 7½ single helical or herringbone gears, treated or untreated, depending on application. They are furnished as desired with either sleeve or Timken tapered roller bearings. It is possible to replace one type of bearing with the other because the bearing housings are identical in both types. However, in case of a change new shafts would have to be provided.

The gears are totally inclosed in a cast-iron case fabricated to lessen the weight. Thus, they are carefully protected from grit and dirt. The bottom of the case serves as a reservoir for lubricant and the gears run in a bath of oil. The bearings are lubricated by a positive splash system. The same lubricant is used for both gears and bearings.

## Electric Heat Helps Thermit Welding

Electric heat has now been applied in connection with thermit welding. The Metal & Thermit Corporation, of Jersey City, N. J., has introduced General Electric heating units on its track-welding equipments for the purpose of assisting the vaporization of the kerosene oil which is used for preheating the work. The oil is passed through the heating unit and is then mixed with compressed air at a pressure of approximately one pound, after which it passes through a rubber hose to the torch used in applying the heat to the rails. In addition, the heating unit acts as a resistor. The equipment is electrically operated from the standard 550/600-volt trolley circuit, and the group of two heating units is connected in series and placed in series with the 230-volt, direct-current motor which drives the compressor. With this arrangement a snap switch can be used to start the motor, as the heating units have sufficient resistance to hold back the inrush of current until the motor comes up to speed.

## Air Pump Company Bought

Announcement is made by the Worthington Pump & Machinery Corporation of the purchase by it of the Harris Air Pump Co. of Indianapolis, Ind., for some years one of the foremost manufacturers of air lift systems and air lift pumps. The purchase was outright and includes patents, drawings, patterns, and good will. This acquisition permits the company to offer complete well equipment, including compressors, produced in its own plants.

## Catalogs

**Jaw Crushers**—Traylor Engineering & Manufacturing Co., Allentown, Pa. Dodge-type jaw crushers. Bulletin 1096, superseding No. 96. Likewise, Bulletin 2097 covers Blake-type jaw crushers, superseding Bulletins J-2 and 1097.

**Boilers**—Straub Manufacturing Co., 507 Chestnut St., Oakland, Calif. Bulletin 100 A. All-steel sectionalized water-tube boilers. Pages 2.

**Chemical Stoneware**—The U. S. Stoneware Co. Akron, Ohio. Bulletin 501. Laboratory sinks, pipe, and fittings of acid-proof chemical stoneware.

**Pulverizers**—Raymond Brothers Impact Pulverizer Co., Chicago, Ill. Catalog 19. Automatic pulverizers.

**Indicators, Signals**—Charles Cory & Son, Inc., 183 Varick St., New York. Bulletin 60-29-A. Annunciators, bells, buzzers, and signal equipment.

**Bar Mills**—Hardinge Co., York, Pa. Bulletin 24, entitled "Operation Notes for Ball Mill Users." Written by Harlowe Hardinge in an effort to improve the operation of the company's ball mills but of interest to users of other ball mills. Price 25c.

**Feldspar**—A pamphlet on its uses. Issued by Goldings Sons Co., Erwin Feldspar Co., and Clinchfield Products Corporation.

**Groundulets** — Crouse Hinds Co., Syracuse, N. Y. Bulletin 2097, superseding Bulletins 2085 and 2089.

**Switches** — Crouse-Hinds, Syracuse, N. Y. Bulletin 221. Type B automatic variable timing switches and control cabinets.

**Welding**—General Electric Co., Schenectady, N. Y. Bulletin GEA-571. Arc welding accessories.

**Welding**—Smith Welding Equipment Corporation, Minneapolis, Minn. Catalog 7. Welding and cutting equipment.

**Mucking**—Myers-Whaley Co., Knoxville, Tenn. Pamphlet, 8 pages. "Tunnel Mucking With Myers-Whaley Shoveling Machines."

**Diamond Drill**—Sullivan Machinery Co., Chicago, Ill. Bulletin 80-B. Mounted diamond drill, Class N, for deep structure testing. Also Bulletin 80-C. Turbinair diamond drill for surface or underground prospecting. Pages 8 each.

**Drill Sharpener**—Sullivan Machinery Co., Chicago, Ill. Bulletin 72-I. All-hammer light drill steel sharpener, Type C. Pages 16.

**Welding**—Alexander Milburn Co., 1416 West Baltimore St., Baltimore, Md. Welding and cutting apparatus. Pages 40.

**Turbo-Generators**—American Brown Boveri Electric Corporation, 165 Broadway, New York. Circular No. 100. Steam turbo-generators. Pages 48.

**Crusher**—Symons Brothers Co., Los Angeles, Calif. Cone crusher. Pages 24.

**Babbitt**—Hoyt Metal Co., St. Louis, Mo. Babbitt metal data book. Twenty pages.

# Market and Financial News

## Signs Fail to Indicate Approach of Serious Depression

### National City Bank Survey Optimistic—Low Money Rates and Rising Bond Prices Encouraging—Freight-Car Requirements Up—Automobile Manufacturers Cautious

THE commonly accepted measures of business indicate that the country has made a good beginning on the new year. Trade has not started off with any great rush, but there has been a good upturn after the quiet period at the year end and business is moving steadily in most lines, says the February letter of the National City Bank. It is recognized as too early to gage the tendencies of the year with much accuracy and the attitude of business generally is one of making haste slowly until the course of spring industry and trade is more clearly defined.

Repeatedly since 1922, the letter continues, a wave of pessimism has spread over the country, having its origin each time apparently in apprehension that capacity to produce is so much in excess of our ability to consume that after a brief "spell" of prosperity we must of necessity have a period of depression while an accumulated surplus is being worked off. A year ago, it will be recalled, business had the same doubts about the forthcoming year that are now being expressed in some quarters relative to 1927, but business belied the pessimists by going on to new heights of prosperity.

The situation at the outset of 1927, it must be admitted, is not quite the same as at the outset one year ago. We have had one more year of very heavy building operations, which must of necessity bring us nearer to the time when building operations will undergo some decline. We have also had another year of heavy production in the automobile industry, with indications that that industry also may not be able to continue without some interruption its record of year to year increases. The decline in agricultural prices, particularly in the case of cotton, tends to disturb the equilibrium of business.

In certain other fundamental respects, however, the situation has not changed. The dominant sustaining factor continues to be the ease of the credit situation. Gold is again flowing into the country in large volume, the total imports during January amounting to more than $50,000,000, making the largest total for any month since 1921, and, together with seasonal liquidation, carrying the volume of federal reserve credit outstanding down to the lowest levels since early in 1925. Whatever the ultimate results of these further additions to our already large gold stocks may be, the immediate effect is to make credit more abundant for commercial and speculative purposes.

Low money rates and rising bond prices such as we are now witnessing, and which have carried representative bond averages to the highest levels since pre-war, are not among the signs of approaching depression. Stimulated by a favorable bond market, new capital issues continue in record-breaking proportions, and each one of these issues represents funds definitely earmarked for expenditure for construction or equipment of some kind. This signifies employment for labor in any event, and tangible support for industrial activity. Easy money, moreover, by facilitating refunding operations is enabling industry to rid itself rapidly of its high yield obligations put out during recent years of high capital costs.

Bank clearings during January have continued to run below the corresponding weeks of a year previous, as in the closing quarter of 1926. Bank debits, however, which include a somewhat larger total, covering as they do not only checks passing through the clearing houses but also those presented directly over the counters of the banks on which they are drawn, make a better showing than the clearings figures, the totals for 141 principal cities for the first four weeks of the year aggregating $51,860,000,000, an increase of 2.6 per cent over those of the same period a year ago, despite the lower level of prices and lessened activity in the security markets. Railway-car loadings for the first two weeks of the year were likewise above the totals for the first two weeks of any previous year.

Estimates of railway-car requirements for the first quarter of the year, prepared by the Mid-West Shippers' Advisory Board and the Atlantic States Shippers' Advisory Board, which met during January, reflect conservative optimism regarding trade for the three months, the expectation generally being that business will at least equal that of the first quarter of 1926, with some lines predicting advances. These reports are prepared in conference with leading shippers and railroad officials in the various districts and are devoid of propaganda, being an attempt to measure as accurately as possible the probable car requirements of individual industries.

In the iron and steel industry the year has begun more quietly than usual, but this is not surprising in view of the sustained activity of 1926. January steel production, however, is expected to run above the 74 per cent rate of December, which will not be a bad showing, even though considerably below the 89 per cent rate of last January. Prices, however, have been under pressure. "Not in many months," says the *Iron Trade Review* in its issue of Jan. 27, "has the finished steel market been so highly competitive."

Automobile production, after dropping to a low ebb in December, was stepped up rapidly in January, but manufacturers are proceeding cautiously, and Detroit employment figures are well below the high points of 1924 and 1926. Records of attendance and business done at the national automobile shows were encouraging, but the industry recognizes that it must await the development of spring buying to get its real cue to the year's business.

Building contracts in the final month of 1926 totaled $537,395,800, a total 2 per cent above December, 1925, bringing the year's total, according to the F. W. Dodge Corporation, to a new high record in excess of $6,800,000,000. Thus the new year begins with probably a larger volume of work under contract than at the start of any previous year.

## British Mining Companies in Mexico Having Tough Sledding

The affairs of British companies operating in Mexico are generally somewhat under a cloud, says *The Economist*, of London, in its Jan. 15 issue. The adverse effects of the fall in silver have been accentuated by legislation and political disturbances, and several mines have reached, or are approaching, the stage of exhaustion. Esperanza has in its time paid handsome dividends, but is now apparently declining. A year ago the decision was arrived at to work the best of the ore available with a view to providing funds for some final exploratory work. The operations of the Mexican company, however, resulted in a net loss of $13,900, increasing the debit to $530,100; further losses have since been made. The funds of the British company are exhausted. Production can scarcely continue much, if any, longer.

### El Oro Approaches Exhaustion

Some time ago it became evident that the area of the El Oro Mining & Railway Co. was approaching exhaustion. The directors met the situation by taking a controlling interest in a silver mine known as La Noria, in Zacatecas. In the 1925 report the ore reserves were estimated as 360,000 tons, value 20 oz. silver. A 200-stamp mill started effectively in May. Returns up to November proved very disappointing, the revenue being reduced by the drop in silver, and expenses swollen by various untoward incidents. For December, however, the profit jumped to nearly $17,000, and this rate is expected to be maintained. The final divident for 1925-26 of the San Francisco —2s. 6d. per share—proved a mild disappointment, that amount having been regarded as the minimum likely to be declared. So far the company's operations have not been appreciably in-

fluenced by the disturbed conditions in the republic, although the kidnapping from a town some 14 miles away from the property of two men associated with the company suggests the possibility of trouble. The "Frisco" [Operations at Parral, Chihuahua], of course, is not much affected by the depreciation in silver, its revenue being mainly derived from lead and zinc. These two metals have, however, also been on the down grade lately. The hopes aroused by the discoveries made last summer in the property of the Buena Tierra company have so far not been fulfilled, and the shares have once again become inactive in a virtually nominal market in the neighborhood of 7s. 6d.

# Burma Corporation Issues Best Report in Its History

### Ends Fiscal Year With Operating Profit of £1,361,357—Improved Work in Concentrator—Production Includes 5,216,102 Oz. Silver and 51,270 Tons of Lead

BURMA CORPORATION, LTD., operating the famous silver-lead mines in the Shan States in Upper Burma, finished the best year in its history, according to the report just issued, in the fiscal year ended June 30, 1926. This record was made in the face of mine fires that impeded operation to some extent during most of the year. The accompanying table gives comparative figures of production during recent years and traces the growth of the enterprize.

There was some decrement in the ore reserves as of July 1, 1926, compared with July 1, 1925, chiefly in respect to tonnage, the average grade being approximately the same. On the later date there were reported 4,140,571 tons of ore, having an average metal content of 22.3 oz. silver; 25.2 per cent lead; 16.6 per cent zinc; and 1.3 per cent copper. The reasons for the shrinkage in the reserves were the necessity of putting a maximum number of men at work on the sinking of the new circular working shaft and the inconveniences occasioned by the fire.

The average daily tonnage of ore extracted from the mine was 976, against 792 for the preceding twelve months, representing an increase of 184 tons, or 23.23 per cent. The total number of shifts worked at the mine in all departments was 1,416,108, against 1,202,562 for the preceding period, equal to an increase of 213,546 shifts, or 17.75 per cent.

Significant items of interest in the mill operations are as follows:

1. Accomplishment of predetermined objectives in the metallurgical work done.

2. Treatment of 6 per cent more tonnage than during the preceding year.

3. Lead concentrate produced and sent to the smelter contained more lead and less zinc per ton than for any other year.

4. Recovery of zinc as a commercial product increased from 22.4 per cent (the preceding year's figure) to 36 per cent (average for period under review), and with gradual improvement finished at 50 per cent for the final quarter of the year.

5. The average assay value of the tailings was less than ever before.

6. Portion of the copper in the ore was separated as a concentrate, containing 20 per cent copper.

The staff in Burma includes E. Hogan Taylor, general manager; A. R. Oberlander, general superintendent; A. B. Colquhoun, head of mining department; E. H. Greig, assistant mine superintendent; T. N. McKenna, head of smelting department, and the following department heads: R. R. Knuckey, milling; J. G. Gillibrand, engineering; M. H. T. Crisp, electrical; L. McDonough, railway; H. T. Taylor, forest, and G. Rogers, ironstone mining.

## Statistical Notes

**Ray Hercules Mines** properties are worth more than $150,000, according to the allegations in a suit of Frank C. Armstrong, a shareholder who says that he owns about one-third of the bonds of the Ray Hercules company, now held by Ellis P. Earle, director of the Chatham-Phenix National Bank & Trust Co. as security for a loan. Mr. Armstrong asks for a restraining order against Mr. Earle and J. Guthrie Hopkins as trustee of the property of Ray Hercules. He says he bought $321,590 of bonds for $200,338 cash, that the copper properties were sold in Arizona in 1924 in mortgage foreclosure proceedings, and that the defendants bought them in for the protection of all the bondholders for $450,000. He asserts that the bondholders are being asked now to consent to the sale of the properties to Mr. Hayden or his representatives for $150,000, and that he for one is opposed on the ground that the sum is inadequate.

**Diamond production** of Union of South Africa in 1926 is valued at £10,700,000, against £8,200,000 in 1925.

**American Metal Co.** has declared a quarterly dividend on the common stock of 75c. Previously $1 quarterly was paid. The company also declared a regular quarterly $1.75 preferred dividend payable March 1. Common dividend is payable March 1. The company has issued the following statement:

"Figures for fourth quarter of 1926 are not available, but in view of indications that net earnings on common stock for the year have not been more than approximately the amount of the dividend, and in view of decline in the price of copper, we deemed it advisable to reduce the quarterly dividend."

**Dome Mines, Ltd.,** producing gold in the Porcupine district in northern Ontario, reports net earnings of $428,335 for the fourth quarter of 1926, compared with $528,411 for the corresponding quarter of 1925. The figures are before allowing for depreciation and depletion. The decrease in operating income was even more, being the difference between $484,969 and $326,271. The preliminary income account for 1926 compares with that of 1925 as follows:

| | 1926 | 1925 |
|---|---|---|
| Gross income | $3,940,089 | $4,366,025 |
| Expenses | 2,357,874 | 2,368,611 |
| Federal taxes | 90,966 | 120,538 |
| Operating profit, before depreciation and depletion | $1,491,249 | $1,876,876 |
| Miscellaneous income | 251,510 | 176,132 |
| Net earnings | $1,742,759 | $2,053,008 |

**Union Minière,** producing copper in the Belgian Congo, reports decreased output for 1926, compared with 1925. The figures are 86,977 short tons, compared with 98,748 in 1925. Production for the two years by months compares as follows:

| | 1925 | 1926 |
|---|---|---|
| January | 7,942 | 6,827 |
| February | 6,418 | 6,810 |
| March | 7,960 | 7,097 |
| April | 7,562 | 7,050 |
| May | 8,856 | 7,547 |
| June | 9,418 | 7,294 |
| July | 9,048 | 7,716 |
| August | 10,004 | 8,188 |
| September | 8,153 | 7,623 |
| October | 8,566 | 6,525 |
| November | 8,224 | 7,260 |
| December | 6,597 | 7,040 |
| Totals | 98,748 | 86,977 |

**National Lead Co.** has offered its employees 16,000 shares of its common stock (par $100) at $140 a share, the stock having been purchased in the open market by the company. Employees will get five years to pay for the stock on the installment plan, or it can be paid for in full and taken up any time after three years. A charge of 5 per cent will be made on unpaid balances. This is the third stock offer to employees of the company. The shares are selling in the market at around $180.

**Platinum production** at Onverwacht, South Africa, in December was 874 oz. Tons milled amounted to 20,250. The November output was 814 oz.; October 618 oz. Previous high production was in July, when output totaled 849 oz.

### Comparative Statistics, Burma Corporation, Ltd.

| Period Ending | Average Value of Ore Extracted: Silver, Ounces | Lead, Per Cent | Zinc, Per Cent | Copper, Per Cent | Production: Ore Mined, Tons | Refined Lead, Tons | Fine Silver, Ounces | Antimonial Lead, Tons | Zinc Concentrate, Tons | Copper Matte, Tons | Working Profit, Rupees |
|---|---|---|---|---|---|---|---|---|---|---|---|
| December, 1921 | 30.5 | 32.8 | 20.2 | 0.10 | 144,089 | 33,694 | 3,540,812 | .... | ..... | .... | 74,67,103 |
| December, 1922 | 25.7 | 28.3 | 17.3 | 0.20 | 172,017 | 39,213 | 4,191,819 | .... | ..... | .... | 1,00,05,238 |
| June, 1923 (6 months) | 20.7 | 23.6 | 15.7 | 0.15 | 118,572 | 21,654 | 2,266,874 | 435 | 855 | .... | 61,81,133 |
| June, 1924 | 22.9 | 24.8 | 15.7 | 0.67 | 277,231 | 47,109 | 5,119,721 | 1,073 | 12,364 | 2,340 | 1,61,01,080 |
| June, 1925 | 20.9 | 22.4 | 13.5 | 1.3 | 289,006 | 48,514 | 5,049,328 | 2,000 | 17,332 | 5,206 | 1,88,44,542 |
| June, 1926 | 19.7 | 20.9 | 12.7 | 1.7 | 356,222 | 51,270 | 5,216,102 | 719 | 33,643 | 9,869 | 1,93,25,998 |

# The Market Report

## Huge Sales of Copper and Lead, With Firmer Prices at Close

### Tin, in Good Demand by Traders, Approaches 70c.—Zinc Neglected —Silver at New High But Reacts

New York, Feb. 9, 1927—It has been an exceedingly mixed week in the metal markets. A few days ago it looked as if the copper market was going to the dogs, but silver was touching new highs for the movement; today, silver is much weaker, but copper sellers are happy at the prospect of big demand at higher prices. An enormous tonnage of lead has been sold, but zinc has been almost entirely neglected. Tin is rising, owing to restricted supplies rather than great consuming demand.

### Copper Bottomed at 12½c.

Copper prices were slashed with a free hand last Thursday, when a large tonnage was sold, mostly at 12⅝ and 12¾c. in the East, and at 13c. and a little less in the Middle West. On Friday most of the business was at 12¾c. in the Middle West and 12.55c. in the East, a further sharp drop. On Saturday, Monday, and Tuesday a good tonnage was sold as low as 12½c. for Eastern deliveries. Not all sellers dropped to this level, but that price could have been obtained in two or three directions. Today, with an excellent week's business behind them and a much stronger metal market in London, sellers were much more optimistic, and the 12½c. copper disappeared. Some was sold this morning at 12.55c., but large lots were booked at 12⅝c. for Eastern deliveries, with sellers feeling cocky and disposed to quote 12¾c. at the close of business. Today's cables from abroad were the most encouraging for some time, reporting an excellent business at the Exporters' new price of 13c., c.i.f.

A study of the sales in recent weeks indicates that consumers of copper are considerably underbought, which accounts for the active market. Buying has been general, with wire and brass mills well represented.

Cutting of prices by the large producers rather than by the much-maligned custom smelters was none too reassuring, and many buyers have been driven away by the violent decline of the last few days. On the other hand, there is every evidence that consumption in the United States will be excellent this spring, with little if any letup from last year's activity. Also, there seems good foundation for the report that 12½c. copper has shocked some of the big producers into serious consideration of a cut in production; this, of course, is the real remedy for low prices.

### Active Buying and Firmer Prices for Lead

Sellers of lead have enjoyed one of the best weeks for several months from the standpoint of volume of sales. A distinct improvement in prices is apparent, particularly yesterday and today. Although the American Smelting & Refining Co. has continued to maintain its official contract price at 7.40c. New York, outside sellers have been able to obtain a premium. Yesterday business was done at 7.50c. and 7.55c. and today as high as 7.60c. has been obtained for small lots, though this is not representative of the market. Buyers in all lines participated actively in the market, with the single conspicuous absence of storage-battery manufacturers. They apparently are uncertain as to their requirements because of the position of the automobile industry. The fact that small buyers have entered the market suggests that they are generally inclined to believe that the bottom has been reached. In the opinion of some observers, one or two small increases in the domestic price would precipitate a buying wave of large proportions, with a too rapid price increase. On the other hand, some of the producers at least have adequate stocks and are in position to meet a reasonable demand. The margin by which it is preferable to ship foreign bullion lead abroad is still wide enough to be effective, but the spread must become much greater before the domestic market can be relieved of ore lead.

### Zinc Dull and Unchanged

Not in weeks has the zinc market been so quiet. Prices have been well maintained between 6.50 and 6.60c., as

### Daily Prices of Metals

| Feb. | Copper | Tin | | Lead | | Zinc |
|---|---|---|---|---|---|---|
| | Electrolytic, N. Y | 99 Per Cent | Straits | N. Y. | St. L. | St. L. |
| 3 | 12 525 | 64 75 | 67 00 | 7 40 | 7 225 | 6.525@6.55 |
| 4 | 12 40 | 65.375 | 67 50 | 7 40 | 7 225@7 25 | 6.50@6 525 |
| 5 | 12.325@12 40 | 65 375 | 67 50 | 7 40 | 7.225@7 25 | 6.50@6.525 |
| 7 | 12 30 | 66 25 | 68 75 | 7 40 | 7.225@7 25 | 6 55@6.60 |
| 8 | 12 30 | 67 00 | 69.50 | 7.425 | 7.25 | 6.55 |
| 9 | 12 40 | 67 125 | 69 625 | 7.45 | 7.25@ 7.30 | 6.60 |
| Av. | 12 381 | 65 979 | 68 313 | 7 413 | 7 244 | 6 548 |

Average prices for calendar week ending February 5, 1927, are: Copper, 12.600c.; 99 per cent tin, 64.625c.; Straits, 66.813c.; N. Y. lead, 7.400c.; St. L. lead, 7.223c.; zinc, 6.535c.; and silver, 59.146c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard.

Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

### London

| Feb. | Copper | | | Tin | | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|
| | Standard | | Electrolytic | | | | | | |
| | Spot | 3M | | Spot | 3M | Spot | 3M | Spot | 3M |
| 3 | 53⅜ | 54⅛ | 60¾ | 297¾ | 291¾ | 26 7/16 | 26¾ | 29¼ | 29¼ |
| 4 | 53¼ | 53⅞ | 60¼ | 298½ | 291¾ | 26 5/16 | 26⅞ | 28 15/16 | 29 1/16 |
| 7 | 52⅞ | 53½ | 59¾ | 302¾ | 295¼ | 26 7/16 | 27 1/16 | 29 5/16 | 29 7/16 |
| 8 | 53 | 53½ | 59½ | 305 | 295½ | 26⅜ | 26⅞ | 29 | 29½ |
| 9 | 53¾ | 54⅜ | 60 | 308 | 296¾ | 26 15/16 | 27½ | 29⅜ | 29 13/16 |

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

### Silver, Gold, and Sterling Exchange

| Feb. | Sterling Exchange "Checks" | Silver | | Gold London | Feb. | Sterling Exchange "Checks" | Silver | | Gold London |
|---|---|---|---|---|---|---|---|---|---|
| | | New York | London | | | | New York | London | |
| 3 | 4 84½ | 60 | 28 | 84s11½d | 7 | 4.84½ | 59⅛ | 27 7/16 | 84s11¼d |
| 4 | 4 84½ | 59¼ | 27¾ | 84s11½d | 8 | 4 84 9/16 | 59 | 27 7/16 | 84s10¾d |
| 5 | 4.84½ | 59 | 27 9/16 | ..... | 9 | 4 84 9/16 | 57¾ | 26 11/16 | 84s11½d |
| | | | | | Avg. | | 59.021 | | |

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

smelters are in no mood to quote lower than that with ore at $42 a ton. Buyers, on the other hand, feel that the January statistics will again be in their favor, and would only be tempted by concessions in price. High-grade continues at 8½@8¾c., delivered, and is also quiet.

### Speculative Buying of Tin

Tin has been going up steadily in London, and the advance has been reflected in the domestic market. On this side dealers have predominated as buyers, consumers being not conspicuous in the picture. Small shipments from the Straits for February are anticipated, and this has apparently tightened the position, especially for prompt metal. The backwardation in London today amounts to almost £12. However, the speculative element is doubtless the strongest factor in the situation.

### Foreign Exchange Steady

Fluctuations in the principal foreign exchanges during the week have been narrow. Spanish pesetas after a sharp advance have reacted. Closing cable quotations on Tuesday, Feb. 8, were: francs, 3.93c.; lire, 4.28¼c.; and marks, 23.70c. Canadian dollars, $\frac{5}{32}$ per cent discount.

### Silver, 57¾c.

The recent advance in silver culminated on Feb. 3, with quotations of 28d. in London and 60c. in New York. The market then receded to a little above the 59c. level, which was maintained for several days, and then dropped sharply on Feb. 9, sales by India and China being responsible for the sudden decline. At the lower level there seems to be a better demand, but the course of silver for the immediate future is still uncertain.

**Mexican dollars** (Old Mexican pesos): Feb. 3, 45⅝c.; 4th, 45c.; 5th, 44⅝c.; 7th, 44⅞c.; 8th, 44⅝c.; 9th, 43⅞c.

### Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

**Aluminum** — Domestic or imported, 98 or 99 per cent grades, 26c. per lb. London, 98 per cent, £105@£107 per long ton for domestic consumption.

**Antimony**—Per lb., duty paid, New York: Chinese brands, spot, 14⅞@15⅛c.; April prices about ⅛c. less; Cookson's "C" grade, spot, 17½c. Market fairly good. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, 16½c.

**Bismuth**—Per lb., New York, in ton lots, $2.70@$2.75. London, 10s.

**Cadmium**—Per lb., New York, 60c.

**Iridium**—Per oz., $115@$120 for 98 @99 per cent sponge and powder.

**Nickel** — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). Contracts for 1927 with principal consumers reported on 30@33c. basis. London, £170@£175 per long ton, according to quantity.

**Palladium**—Per oz., $58@$62. Pure metal as a constituent of crude platinum, $55@$59 per oz. London, £11@£12, nominal.

**Platinum** — Official price quoted by the leading interest on miscellaneous orders for refined metal, $107 per oz. Open market cash sales of large lots, in New York, $101@$104. Pure metal as a constituent of crude platinum, $97@$99. Market steadier.

London, £22 per oz. for refined and £19@£20 for crude. Dull.

**Quicksilver**—Per 75-lb. flask, $100@$102 for spot, depending upon quantity. San Francisco wires $101.33, steady. London, £17@£17¼.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the issue of Feb. 5.

### Metallic Ores

**Manganese Ore**—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c. Caucasian (washed), 53@55 per cent, 38@40c. Chemical grades unchanged from Feb. 5 issue.

**Tungsten Ore** — Per unit of $WO_3$, N. Y.: Wolframite, $10.75@$11; Western scheelite, $11.25@$11.50. Market firm on small business.

**Chrome, Iron, Molybdenum, Tantalum, Titanium, Uranium, and Vanadium Ores** are unchanged from quotations in the Feb. 5 issue.

### Zinc Blende and Lead Ore Prices Unchanged

**Joplin, Mo., Feb. 5, 1927**

**Blende**

| | |
|---|---|
| High | $47.15 |
| Premium blende, basis 60 per cent zinc | 43.00@ 44.00 |
| Prime Western, basis 60 per cent zinc | 42.00 |
| Fines and slimes, 60 per cent zinc | 41.00@ 38.00 |
| Average settling price, all zinc | 42.97 |

**Galena**

| | |
|---|---|
| High | 96.50 |
| Basis 80 per cent lead | 90.00 |
| Average settling price, all lead | 94.27 |

Shipments for the week: Blende, 10,151; calamine, 44; lead, 1,817 tons. Value, all ores the week, $608,750.

The zinc quotations are those reported as the market today, but it is current comment that two buyers bought in mid-week eight carloads each on a $44 basis price for Prime Western grades. All other buyers continued to hold offerings on the $42 basis price. Purchases are very light, the shipments recording around 10 per cent from the smelting companies' own mines.

Restriction of production, occasioned by mines closing down from inability to market concentrate on the present market price, totals approximately 20 to 25 per cent of an average output, or about 3,000 to 3,500 tons per week.

A majority of the mines forced to cease production are producers of only a small tonnage of lead, reducing the output of this mineral about 10 per cent.

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**Platteville, Wis., Feb. 5, 1927**

| Zinc Blende | Per Ton |
|---|---|
| Blende, basis 60 per cent zinc | $44.75 |
| **Lead Ore** | |
| Lead, basis 80 per cent lead | $95.00 |

Shipments for the week: Blende, 1,233 tons; lead, 40 tons. Shipments for the year: Blende, 7,287; lead, 180 tons. Shipments for the week to separating plants, 2,230 tons blende.

### Non-Metallic Minerals

**Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fullers Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli,** and **Zircon** are unchanged from prices in the Feb. 5 issue.

### Mineral Products

**Arsenious Oxide (White Arsenic)**—3¾c. per lb. Quiet.

**Calcium Molybdate, Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake),** and **Zinc Oxide** are unchanged from prices in the Feb. 5 issue.

### Ferro-Alloys

**Ferromanganese**—Domestic and foreign, 78@82 per cent, $100 per long ton, furnace or duty paid, for delivery during first half of 1927. Spiegeleisen, 19@21 per cent, $36@$37, f.o.b. furnace; 16@19 per cent, $34@$35.

**Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium** and **Ferrovanadium** are unchanged from prices in the Feb. 5 issue.

### Metal Products

**Rolled Copper**—Sheets, 21¼c.; wire, 14½c., f.o.b. mill.

**Lead Sheets**—Full rolled, 11c. per lb.; clipped, 11¼c.

**Nickel Silver**—28¼c. per lb. for 18 per cent nickel Grade A sheets.

**Yellow (Muntz) Metal**—Dimension sheets, 18⅝c. per lb.; rods, 15⅝c.

**Zinc Sheets**—11c. per lb., f.o.b. mill.

### Refractories

**Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick** and **Zirkite** are unchanged from quotations in the Feb. 5 issue.

### Steel Active at Lower Prices—Pig Iron and Coke Dull

**Pittsburgh, Feb. 8, 1927**

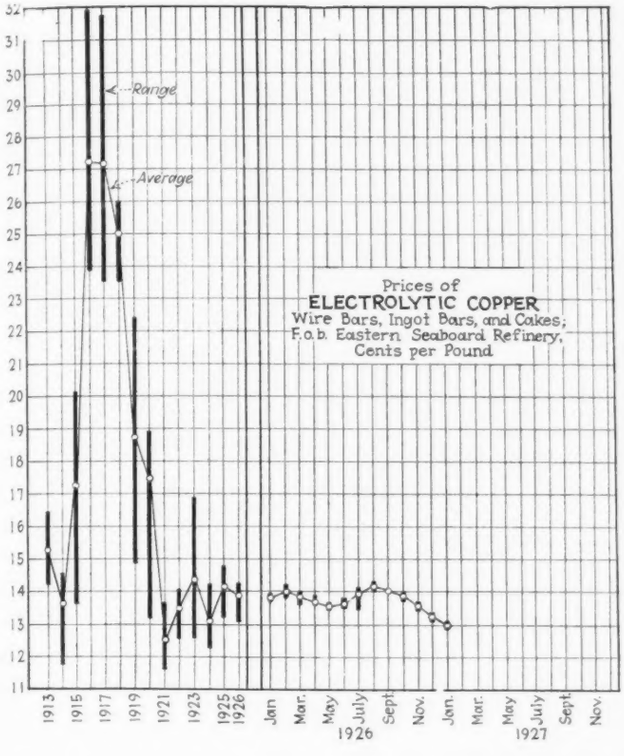
Demand for steel continues to increase slowly. Buying is very widespread in character, with a very conservative attitude on the part of all buyers, orders being numerous, but small individually.

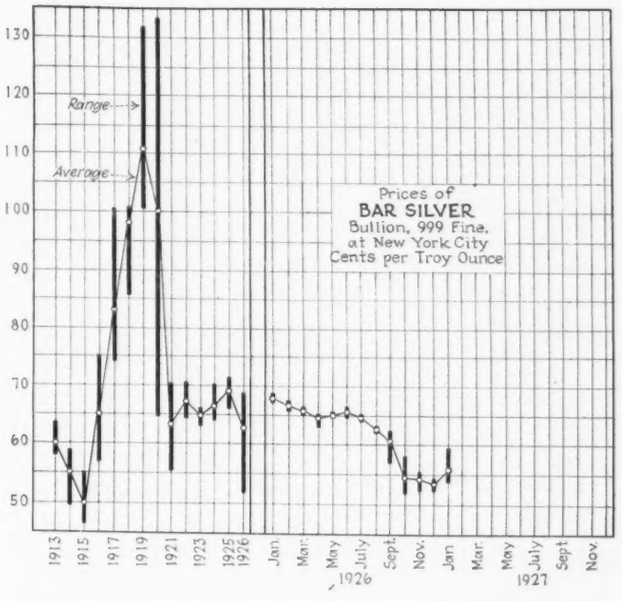
Steel mill operations have climbed to a rate above 80 per cent, against a 74 per cent average in December, but 88 to 89 per cent in January and February of last year.

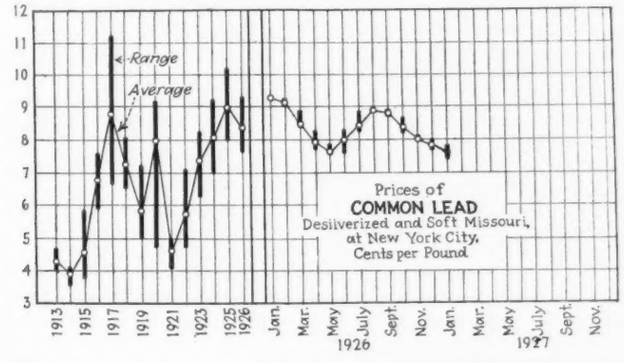
**Pig Iron**—Bessemer pig iron at Valley furnaces has slipped from $19.50 to $19, chiefly to put it in line with the other grades, which remain quotable at $18 for basic and $18.50 for foundry.

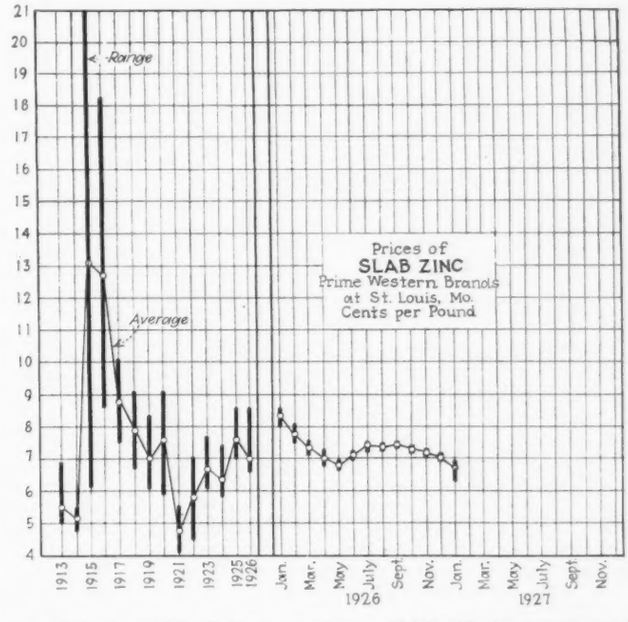
**Connellsville Coke** — Spot furnace coke, $3.25. Spot foundry remains at $4.25 to $4.75.

# Metal Price Curves

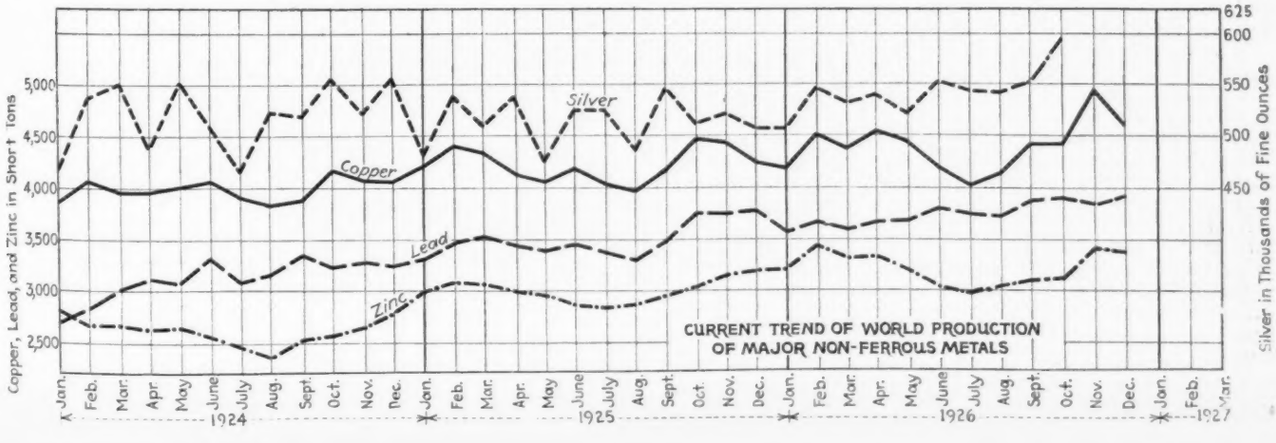



THE curves below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output, according to latest estimates of the American Bureau of Metal Statistics. The figures represent countries that produced in 1924 and 1925 about 97 per cent of the world's output of copper; 78 per cent of the lead; 87.5 per cent of the zinc; and 81 per cent of the silver. Figures now being published by the Bureau include a larger proportion of the world output than those stated. However, until these have been in effect for a sufficient period of time to give a "history" for purpose of comparison, it is thought desirable to make the necessary adjustment in the data and extend the curve on the basis that has been in vogue for two years.



# Review of Current Statistics

By A. B. Parsons
Assistant Editor

FOR the fifth consecutive month the *Engineering and Mining Journal's* Weighted Index of Non-Ferrous Metal Prices showed a decisive drop in January. The figure, 100.46, compares with 102.31 in December and 112.66 in January a year ago. Silver, which increased from an average of 53.466c. to 55.795c. and nickel, which did not change, were the only major metals that did not participate in the decline. In order of importance in their effect on the weighted index, the other metals are copper, lead, zinc, tin, and aluminum. Prices for copper, lead and zinc, each reached during the month lower levels than at any time since the middle of 1924. Since Feb. 1, lead and zinc have been steady, but copper has shown further tendency to weaken.

After several exceedingly quiet weeks during which most of the producers were asking considerably above the market, a brief buying wave at about 13c. was followed by another period of dullness, during which prices sagged to 12.50c., delivered in Connecticut. There is little reason to doubt that a large volume of buying for March and April delivery is sure to develop; but the price at which buyers will enter the market on a large scale is a matter of doubt. Sellers think active buying and a definite upward swing in price should start soon. Copper certainly looks cheap at the current price; but, with sundry increases in production either recently effected or looming on the horizon, buyers are enjoying a strategic advantage.

The Aluminum Company of America cut its price for 99 per cent aluminum from 27c. to 26c. in line with the outside market.

Apropos of the general industrial outlook for the first half of the year the Harvard Economic Service comments as follows:

"An important—though not the sole—cause of the sustained business activity of the past few years has been the maintenance of easy money conditions; and, as we have previously pointed out, no period of business depression in this country has been preceded by a period of easy money. Such conditions normally follow a period of depression—they do not usher it in. We believe, therefore, that the present period of hesitation (the more noticeable because of the seasonal dullness which customarily characterizes the opening of the year) will be temporary. General business may average somewhat lower than during the latter months of 1926, but we expect it to proceed at an active pace during the present half year."

If this view, which corresponds generally with those expressed by most of the well-known economic forecasters, proves to be correct, it would appear that metal producers should be able to dispose of almost as much metal as they have been producing in recent especially active months. That a modest curtailment in the rates of output would do much to stiffen the prices of the next few months is argued by many sellers.

In this connection it is significant that production of zinc in the Joplin district has been curtailed sharply; and the American Smelting & Refining Co. has put into effect a reduction of 15 per cent in the current rate of output of lead from the mines under its own control. Though this will affect only a small proportion of the intake of the A. S. & R. smelting plants the adoption of a similar policy by the leading producers in the lead-mining industry would be a potent influence in the market and a favorable influence from the producers' point of view. Since there apparently are few altruists in the industry, the decision to curtail will be decided by each company on the basis of estimating its own probable net profits with curtailment and without. Much the same problem has faced the copper producers many times; the way they have answered it can be seen in the production figures, and perhaps the price figures.

**E.&M.J. Weighted Index of Non-Ferrous Metal Prices**

100 Is Composite for 1922-3-4

| | |
|---|---|
| 1920 | 130.92 |
| 1921 | 80.80 |
| 1922 | 93.94 |
| 1923 | 103.43 |
| 1924 | 102.63 |
| 1925 | 111.74 |
| 1926 | 107.74 |

| | 1925 | 1926 | 1927 |
|---|---|---|---|
| July | 108.81 | 109.08 | |
| August | 113.61 | 110.22 | |
| September | 114.66 | 109.27 | |
| October | 115.64 | 106.20 | |
| November | 116.69 | 104.21 | |
| December | 114.15 | 102.31 | |
| January | 116.38 | 112.66 | 100.46 |

Silver producers are well pleased with the upward trend of the market. Since the first of February the price has touched 60c., something that was not looked for by many a month ago. The course of the market in the immediate future, however, is likely to be downward, for the reason that the causes to which the advance is generally ascribed are temporary in character. At the same time various forces affecting the silver market are at work in China, and no forecast regarding the future can be made with assurance.

The slight rise in the Weighted Index of Non-Metallic Mineral prices is attributed to advances in asbestos and barytes. Prices for spinning grades of asbestos and for shingle stock have been increased during the month by the "trust" in Quebec.

Declines in American Smelting & Refining and Anaconda contributed most to the lowering of the index for the mining - smelting - manufacturing shares. At the same time each of the others in the group receded, with the exception of International Nickel, which reached its high point for the past year. Discovery of high-grade ore in the Frood mine is the probable reason for the climb.

Increasing uncertainty regarding Mexico presumably was a factor in the decline of A. S. & R. shares, as well as those of American Metal and U. S. Smelting—although the last two were not important. Compared with August, 1926, each of the three is off from 5 to 10 points.

Three exceptions from the general decline in coppers are Calumet & Hecla, New Cornelia, and Chile. The weakness in the metal market is doubtless reflected to an extent in the lower share prices. Inspiration and United Verde Extensions suffered most.

Featuring the miscellaneous group of gold-silver-lead-zinc companies is the remarkable showing of Lake Shore, operating in the Kirkland Lake gold area in Northern Ontario. During January the shares made a net advance of more than $3; and at one time during the month touched $19, indicating a total share value for the property of $38,000,000. Favorable developments on the lower horizons of a mine, thus far developed to only a shallow depth, are responsible for the advance. Hollinger likewise reached a new high, touching $21 for a valuation of nearly $105,000,000. The probability of attaining an output of 8,000 tons per day by fall is "intriguing" the investing public.

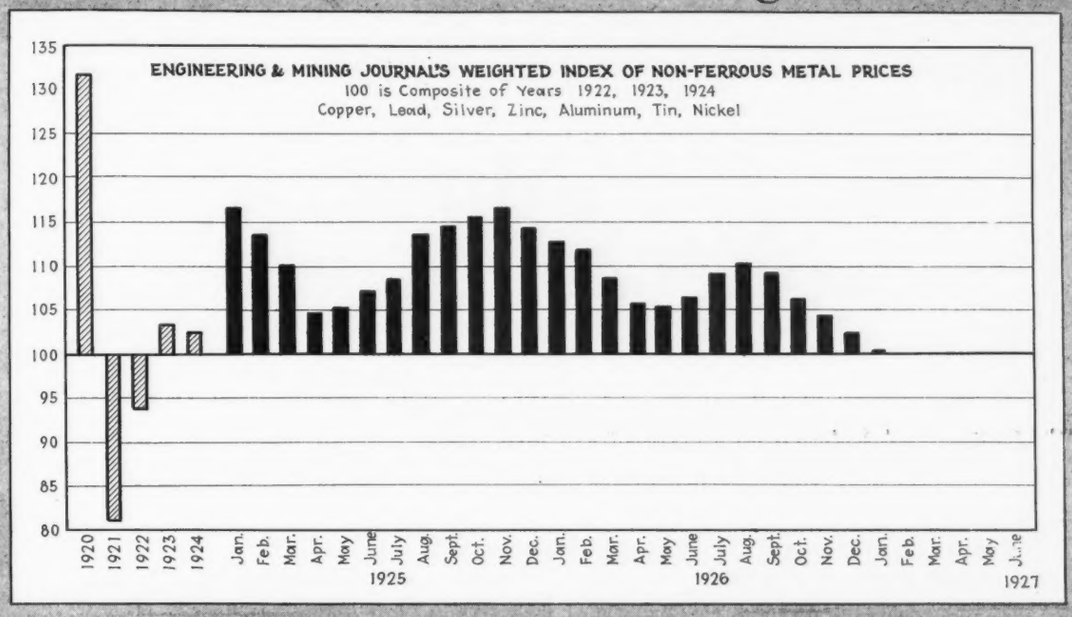
Cerro de Pasco and Howe Sound, among the important silver producers, and Hecla and Homestake declined. Howe Sound, producing silver, copper, lead, and zinc, is experiencing a declining market for three of the four metals it has for sale. Earnings for the fourth quarter of 1926 were measurably less than for the third.

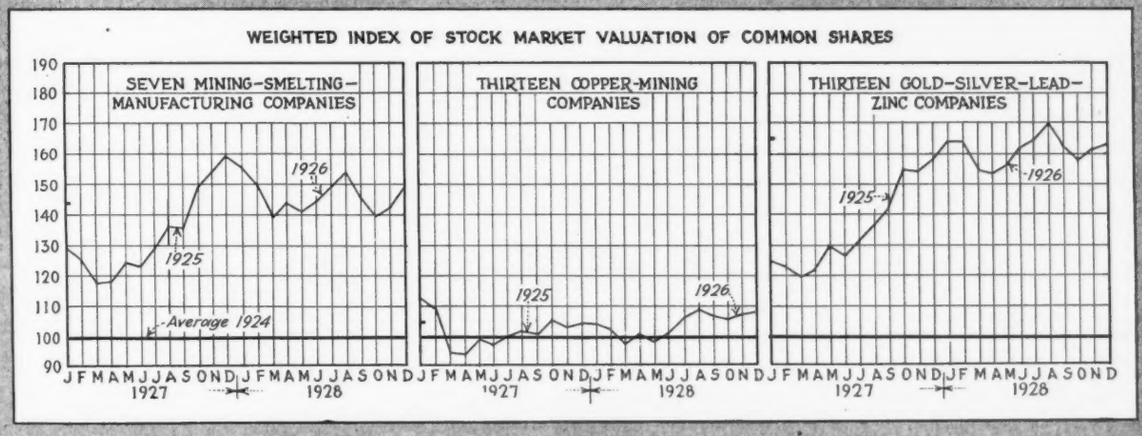
Statistics of world's production rates shown in the graph at the bottom of page 309 reveal a sharp decline in copper output in December as compared with November; but nevertheless the rate is higher than ever before in history. Lead production reached a new high in December; and zinc continued at a high rate. It is possible that the January figures will show a decided drop, with the chances favoring zinc and lead more than copper.

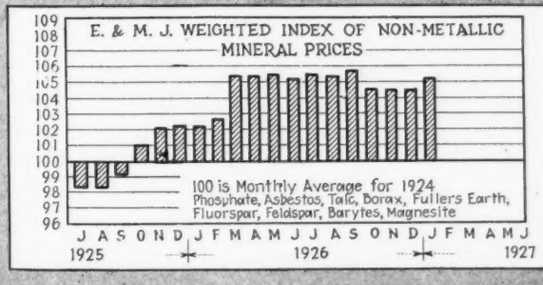
Belated publication of figures on Mexico's silver production in October show a record-breaking world output for that month. The absence of data from Mexico for November and December prevents the extension of the silver curve. However, the United States and Canada produced approximately the same in December as in October, and Peru and Australia appear to have increased output; so, unless some erratic change occurs in the Mexican figures, a decline in the total is not likely.

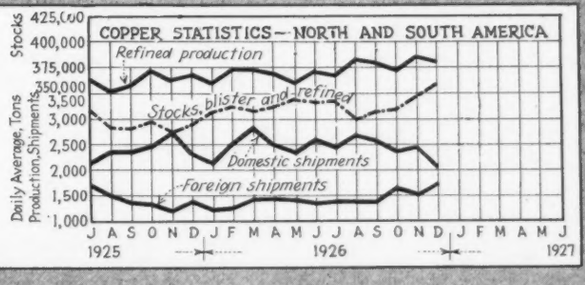
The American Bureau of Metal Statistics is to be credited for the data of production and stocks shown in the curves on page 311.

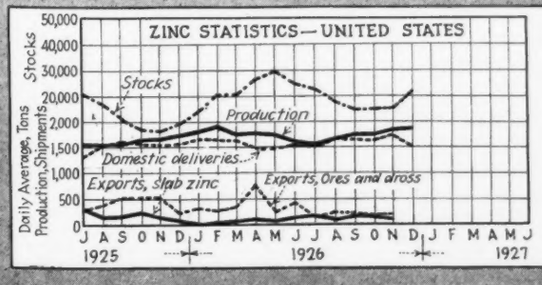
# E.&M.J. Statistics of the Mining Industries

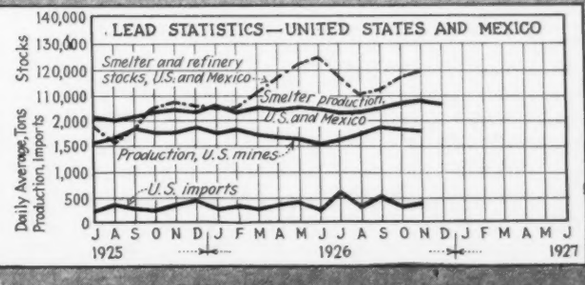

ENGINEERING & MINING JOURNAL'S WEIGHTED INDEX OF NON-FERROUS METAL PRICES
100 is Composite of Years 1922, 1923, 1924
Copper, Lead, Silver, Zinc, Aluminum, Tin, Nickel
1925
1926
1927





E. & M. J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate, Asbestos, Talc, Borax, Fullers Earth, Fluorspar, Feldspar, Barytes, Magnesite
1925
1926
1927



# Mining Stocks—Week Ended February 5, 1927

| Stock | Exch. | High | Low | Last | Last | Div. |
|---|---|---|---|---|---|---|
| **COPPER** | | | | | | |
| Anaconda | New York | 47⅜ | 46½ | 46¾ | Ja. 15, Fe. 21 | Q 0.75 |
| Arcadian Consol. | Boston | *50 | *50 | *50 | ... | ... |
| Ariz. Com'l | Boston | 9½ | 9 | 9 | Ja. 7, Ja. 28 | 0.50 |
| Calaveras | N. Y. Curb | 1½ | 1½ | 1½ | ... | ... |
| Calumet & Arizona | New York | 68⅜ | 66½ | 66½ | De. 3, De. 20 | Q 1.50 |
| Calumet & Hecla | Boston | 16½ | 15½ | 15⅝ | Fe.28, Ma.15 | Q 0.50 |
| Cerro de Pasco | New York | 62⅛ | 60½ | 61½ | Ja.13,Fe.1, | Q 1.00 |
| Chile Copper | New York | 35½ | 35 | 35⅛ | Ma.4,Apr.1, | Q 0.62½ |
| Chino | New York | ... | ... | 22½ | ... | ... |
| Con. Coppermines | N. Y. Curb | 2⅜ | 2⅜ | 2⅜ | ... | ... |
| Copper Range | Boston | 13⅜ | 13 | 13 | May, 1926 | 1.00 |
| Crystal Copper | Boston Curb | *29 | *25 | *28 | ... | ... |
| East Butte | Boston | 2⅜ | 2 | 2⅜ | Dec., 1919 | 0.50 |
| First National | Boston Curb | *9 | *9 | *9 | Feb., 1919 | 0.15 |
| Franklin | Boston | *25 | *10 | *10 | ... | ... |
| Granby Consol | New York | 32⅜ | 31⅜ | 32½ | May, 1919 | 1.25 |
| Greene-Cananea | New York | 30⅜ | 29⅞ | 30⅛ | Nov., 1920 | 0.50 |
| Hancock | Boston | ... | ... | *75 | ... | ... |
| Howe Sound | New York | 40½ | 38½ | 40 | De.31, Ja.15 | Q 1.00 |
| Inspiration Consl. | New York | 24⅜ | 23⅜ | 23⅝ | De.16, Ja.3, | Q 0.50 |
| Iron Cap | Boston Curb | 2½ | 2 | 2½ | ... | ... |
| Isle Royale | Boston | 11 | 11 | 11 | Fe.4, Fe.19 | Q 0.50 |
| Jerome Verde Dev | N. Y. Curb | *35 | *35 | *35 | ... | ... |
| Kennecott | New York | 61⅛ | 61 | 61½ | Mar. 4Apr. 1 | Q 1.25 |
| Lake Copper | Boston | *95 | *90 | *90 | June, 1925 | 0.50 |
| Magma Copper | New York | 35⅜ | 34½ | 35⅜ | Dec.1, Ja.15, | Q 0.75 |
| Mason Valley | N. Y. Curb | 1⅜ | 1⅜ | 1⅜ | ... | ... |
| Mass Consolidated | Boston | *35 | *25 | *25 | Nov., 1917 | 1.00 |
| Miami Copper | New York | 15⅞ | 15⅛ | 15½ | Fe.1, Fe. 15 | Q 0.37½ |
| Mohawk | Boston | 38½ | 38 | 38 | Ja.29, Ma.1 | Q 1.00 |
| Mother Lode Coa | New York | 4⅜ | 4½ | 4½ | De.10, De.31 | SA 0.37½ |
| Nevada Consol | New York | 14⅜ | 14 | 14⅛ | De.15, De.31 | Q 0.37½ |
| New Cornelia | Boston | 23 | 22½ | 22½ | Fe.4, Fe.21 | Q 0.50 |
| Noranda | N. Y. Curb | 21⅞ | 19⅞ | 21½ | ... | ... |
| North Butte | Boston | 3½ | 2⅞ | 3 | Oct., 1918 | 0.25 |
| Ohio Copper | N. Y. Curb | *45 | *45 | *45 | Se. 1, Se. 15 | 0.03 |
| Old Dominion | Boston | 13½ | 13 | 13 | Dec., 1918 | 1.00 |
| Phelps Dodge | Open Mar. | †127 | †123 | ... | De.24, Ja.3 | Q 1.50 |
| Quincy | Boston | 16 | 16 | 16 | Mar., 1926 | 1.00 |
| Ray Consolidated | New York | 15⅛ | 14⅜ | 14⅝ | Ap.20, Ap.30 | 0.25 |
| St. Mary's Min. Ld. | Boston | 24⅛ | 23½ | 23½ | May, 1926 | 2.00 |
| Seneca Copper | New York | 3⅜ | 2½ | 2½ | ... | ... |
| Shannon | Boston | ... | ... | *25 | Nov., 1917 | 0.25 |
| Shattuck-Denn | Boston Curb | 5⅛ | 5⅛ | 5⅛ | ... | ... |
| Superior & Boston | Boston | *30 | *20 | *20 | ... | ... |
| Tenn. C. & C. | New York | 11⅞ | 11⅛ | 11⅛ | No.30, De.15, | Q 0.25 |
| United Verde Ex | N. Y. Curb | 25 | 23 | 25 | Ja. 6, Fe. 1 | 0.75 |
| Utah Copper | New York | 113⅛ | 113⅛ | 113⅜ | De.15,De.31 | Q 1.50 |
| Utah Metal & T | Boston | 2 | 1⅛ | 1⅛ | Dec., 1917 | 0.30 |
| Victoria | Boston | ... | ... | *65 | ... | ... |
| Walker Mining | Salt Lake | 1 | *95 | *99 | ... | ... |
| **NICKEL-COPPER** | | | | | | |
| Internat. Nickel | New York | 42 | 40½ | 40⅜ | De.16, De.31, | Q 0.50 |
| Internat. Nickel, pfd. | New York | 106½ | 106 | 106 | Ja. 13, Fe.1, | Q 1.50 |
| **LEAD** | | | | | | |
| Gladstone Mtn | Spokane | *29⅜ | *28 | *28 | Ja. 1927 | 0.005 |
| National Lead | New York | 166½ | 162⅛ | 164⅜ | De.10, De.31 | Q 2.00 |
| National Lead pfd | New York | 117½ | 117½ | 117½ | No.19,De.15 | Q 1.75 |
| St. Joseph Lead | New York | 41½ | 41 | 41 | Jn.10,Jn.20, | QX 0.75 |
| **ZINC** | | | | | | |
| Am. Z. L. & S | New York | 9½ | 8⅛ | 9 | May, 1917 | 1.00 |
| Am. Z. L. & S, pfd | New York | 48 | 46 | 47½ | Nov., 1920 | 1.50 |
| Butte C. & Z | New York | 4⅛ | 4 | 4 | De.9, De.24 | 0.50 |
| Butte & Superior | New York | 11⅜ | 10⅛ | 10⅜ | De.9, De.24 | Q 0.50 |
| Callahan Zn-Ld | New York | 2⅛ | 1⅞ | 1⅞ | Dec., 1920 | 0.50 |
| Eagle-Picher | Cincinnati | 26⅜ | 26⅛ | 26⅛ | No.15, De.1 | Q 0.40 |
| Eagle-Picher, pfd | Cincinnati | ... | ... | 100 | De.31, Ja.15 | Q 1.50 |
| New Jersey Zn | N. Y. Curb | 186 | 184⅜ | 185⅛ | Ja.20, Fe.10 | Q 2.00 |
| United Zinc | N. Y. Curb | ... | ... | 55 | ... | ... |
| Yellow Pine | Los Angeles | *28½ | *22½ | *27½ | Dec. 1925 | Q 0.04 |
| **GOLD** | | | | | | |
| Alaska Juneau | New York | 1⅛ | 1⅛ | 1⅛ | ... | ... |
| Argonaut | Toronto | *48⅛ | *41 | *47⅜ | ... | ... |
| Barry-Hollinger | Toronto | *86 | *70 | *77 | ... | ... |
| Carson Hill | Boston | *20 | *18 | *20 | ... | ... |
| Consol. W. Dome L. | Toronto | *19 | *15 | *16 | ... | ... |
| Cresson Consol. G | N. Y. Curb | 2⅝ | 2⅛ | 2⅛ | De.31, Ja.10 | Q 0.10 |
| Crown Reserve | Toronto | *10 | *9 | *9 | Jan., 1917 | 0.05 |
| Dome Mines | New York | 9⅜ | 9⅛ | 9⅝ | De.31 ,Ja.30, | Q 0.50 |
| Golden Center | N. Y. Curb | 1⅜ | 1⅛ | 1⅜ | ... | ... |
| Golden Cycle | Colo Springs | †1.77 | †1.74½ | .... | No.30, De.10 | Q 0.04 |
| Hollinger Consol | Toronto | 22.75 | 20.25 | 22.40 | Fe.9, Fe.25 | 0.10 |
| Homestake Mining | New York | 60½ | 60 | 60½ | Fe.19, Fe.25 | MO 0.50 |
| Kirkland Lake | Toronto | *94 | *89⅛ | *92 | ... | ... |
| Lake Shore | Toronto | 18.60 | 17.65 | 18.25 | De.2,De.15 | X 0.20 |
| McIntyre-Porcupine | New York | 27 | 25⅞ | 26⅞ | Fe.1, Ma.1 | Q 0.25 |
| Newray | Toronto | *30⅜ | *30⅜ | *30⅜ | ... | ... |
| Night Hawk Pen | Toronto | *6 | *4½ | *6 | ... | ... |
| Portland | Colo Springs | †*53½ | †*52 | .... | Ja.6, Ja.15, '27 | 0.02 |
| Rand Mines | New York | .... | .... | 9½ | Au.23–30 | Am.Sh. 1.52 |
| Teck-Hughes | Toronto | 6.50 | 5.85 | 6.25 | Ja.31, Fe. 1 | 0.05 |
| Tom Reed | Los Angeles | *60 | *55 | *60 | Dec., 1926 | 0.02 |
| Tough-Oakes | Toronto | *61 | *58½ | *60⅜ | ... | ... |
| United Eastern | N. Y. Curb | *52 | *50 | *50 | July, 1924 | 0.05 |
| Vipond Cons | Toronto | 1.72 | 1.64 | 1.64 | ... | ... |
| Wright-Hargreaves | Toronto | 11.00 | 9.70 | 10.70 | Ja15,Fe.1 | QX 0.15 |
| Yukon-Alaska Trust | N. Y. Curb | .... | .... | 20 | ... | ... |
| **GOLD AND SILVER** | | | | | | |
| Carnegie Metals | Pittsburgh | 13 | 13 | 13 | ... | ... |
| Con. Cortez | N. Y. Curb | *9 | *9 | *9 | ... | ... |
| Con. Virginia | San Francisco | *6½ | *6½ | *6½ | ... | ... |
| Continental Mines | N. Y. Curb | ... | ... | *15 | ... | ... |
| Dolores Esperanza | N. Y. Curb | *45 | *38 | *45 | July, 1923 | 0.05 |
| Premier Gold | N. Y. Curb | 2⅛ | 2 | 2⅛ | De.17, Ja.4 | Q 0.08 |
| Tonopah Belmont | N. Y. Curb | 2 | 1⅜ | 1⅝ | Se.15, Oc.1 | 0.05 |
| Tonopah Extension | N. Y. Curb | *30 | *30 | *30 | Apr. 1925 | 0.05 |
| Tonopah Mining | N. Y. Curb | 3 | 3 | 3 | Se.30, Oc.21 | SA 0.07½ |
| West End Consol | N. Y. Curb | *15 | *9 | *13 | Mar., 1923 | 0.05 |
| Yukon Gold | N. Y. Curb | ... | ... | *40 | June, 1918 | 0.02 |

| Stock | Exch. | High | Low | Last | Last | Div. |
|---|---|---|---|---|---|---|
| **SILVER** | | | | | | |
| Beaver Consol | Toronto | *72 | *66 | *70 | May. 1920 | 0.03 |
| Canadian Lorrain | Toronto | *72 | *63 | *63 | ... | ... |
| Castle-Trethewey | Toronto | 1.45 | 1.20 | 1.20 | ... | ... |
| Comagas | Toronto | 4.20 | 4.18 | 4.20 | May, 1924 | 0.12½ |
| Keeley | Toronto | 1.66 | 1.60 | 1.61 | Fe.28, Ma. | X 0.12 |
| Kerr Lake | N. Y. Curb | *83 | *78 | *80 | Oc.1, Oc.15 | SA 0.12½ |
| La Rose | Toronto | ... | ... | *10 | Apr., 1922 | 0.10½ |
| Lorrain Trout Lake | Toronto | *40 | *30 | *40 | July, 1925 | 0.05 |
| McKinley-Dar.-Sav | Toronto | *13 | *12 | *13 | Oct., 1920 | 0.03 |
| Mining Corp. Can | Toronto | 3.50 | 3.30 | 3.40 | De.30, Ja.15 | 0.12½ |
| Nipissing | N. Y. Curb | 10⅛ | 9⅝ | 10 | De.31, Ja.20 | Q 0.15 |
| Temiskaming | Toronto | ... | ... | *7 | Jan., 1920 | 0.40 |
| **SILVER-LEAD** | | | | | | |
| Ahumada | New York | 4⅜ | 4⅛ | 4⅛ | De.18,Ja.5, | QX 0.15 |
| Bingham Mines | Boston | 46 | 41⅜ | 44 | De.30, Ja.5 | Q 1.00 |
| Cardiff M. & M | Salt Lake | *50 | *37 | *37 | Nov., 1924 | 0.10 |
| Chief Consol | Salt Lake | 3.05 | 2.92½ | 2.92½ | Oc.10, No.1 | Q 0.10 |
| Consti'n Mng. & Mill'g | Spokane | *25½ | *23 | *24 | ... | ... |
| Erupcion | Boston Curb | 1 | *95 | 1 | De.18, Ja.3, | Q 0.10 |
| Federal M. & S | New York | ... | ... | 88 | ... | ... |
| Federal M. & S., pfd. | New York | 76½ | 76 | 76 | No.24, De.15 | Q 1.75 |
| Hawthorne Mines | N. Y. Curb | *7 | *6 | *7 | ... | ... |
| Hecla Mining | N. Y. Curb | 14⅜ | 14 | 14⅜ | No.15,De.15 | Q 0.50 |
| Highland-Surprise | Spokane | *15 | *14½ | *14½ | ... | ... |
| Iron King Mining | Salt Lake | *29 | *25 | *29 | ... | ... |
| Keystone Mining | Salt Lake | *31 | *27 | *31 | Au.12, Au.26 | 0.07½ |
| Lucky Jim | Spokane | *16 | *15 | *15 | ... | ... |
| Lucky Tiger-Com | Kansas City | †7.40 | †6.87½ | .... | Dec. 20, 1926 | 0.12 |
| Mammoth Mining | Salt Lake | 2.65 | 2.65 | 2.65 | De.17, De.23, | Q 0.25 |
| Marsh Mines | Spokane | 2.75 | 2.25 | 2.25 | ... | ... |
| Park Utah | New York | 7½ | 6⅜ | 7½ | De.15, Ja.2 | Q 0.15 |
| Plutus Mining | Salt Lake | 2.20 | 2.20 | 2.20 | Ja.10, Ja.15 | Q 0.10 |
| San Rafael | San Francisco | .... | .... | *28 | ... | ... |
| Silver King Coal | Salt Lake | 8.10 | 8.00 | 8.10 | De. 16, Ja.3 | 0.25 |
| Silversmith | Spokane | *35½ | *31½ | *31½ | Oc.1, Oc.10 | Q 0.02 |
| Strattons Mines | Spokane | *44 | *42 | *44 | ... | ... |
| Sunshine M. Co | Spokane | *48 | *43½ | *44½ | ... | ... |
| Tamarack-Custer | Spokane | *42½ | *36 | *37 | Sept., 1924 | 0.25 |
| Tintic Standard | Salt Lake | 11.00 | 10.87½ | 10.87½ | De.11, Ja.3 | 0.30 |
| Utah-Apex | Boston | 6½ | 6 | 6½ | Oc.3, Oc.15 | Q 0.25 |
| **IRON** | | | | | | |
| Bethlehem Steel | New York | 46⅜ | 45 | 45½ | July, 1924 | 1.25 |
| Cleveland-Cliffs Iron | Cleveland | 80 | 74 | 74 | Ja.15, Ja.25 | Q 1.00 |
| Colorado Fuel & Iron | New York | 56½ | 50½ | 55½ | May, 1921 | 0.75 |
| Gt. North'n Iron Ore | New York | 23½ | 21⅜ | 22 | Dec.6, Dec.28 | 0.75 |
| Inland Steel | New York | 41⅞ | 41⅜ | 41⅝ | Fe. 15, Ma.1 | Q 0.62½ |
| Mesabi Iron | New York | ... | ... | *95 | ... | ... |
| Replogle Steel | New York | 11⅛ | 10⅞ | 11 | ... | ... |
| Republic I. & S | New York | 61½ | 59½ | 60⅜ | Fe.15,Ma. 1 | Q 1.0 |
| Republic I. & S. pfd. | New York | 100 | 100 | 100 | Ma.15, Ap.1 | Q 1.75 |
| Sloss-Sheffield S. & I. | New York | 128¼ | 126½ | 127 | De.10, De.20 | Q 1.50 |
| Sloss-Shef. S.&I. pfd. | New York | ... | ... | 108 | De.20, Ja.3 | Q 1.75½ |
| U. S. Steel | New York | 158⅜ | 155⅜ | 156⅝ | Fe.28,Ma.30 | Q 1.75 |
| U. S. Steel pfd | New York | 114 | 112⅜ | 113⅛ | Ja.29, Fe.26, | Q 1.75 |
| Virginia I. C. & C. | New York | ... | ... | 45 | Jan., 1924 | 1.500 |
| Virginia I.C.&C.pfd | New York | ... | ... | 60½ | De.15, Ja.2, | 2.50 |
| **DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN** | | | | | | |
| De Beers Consol | New York | ... | ... | 32⅜ | Ja.26, Ja.29 | 1.45 |
| So. Am. Gold & P | N. Y. Curb | 3⅜ | 3⅜ | 3⅜ | ... | ... |
| Alum.Co.of Amer | N.Y.Curb | 72½ | 70⅜ | 72½ | ... | ... |
| Alum. Co. of Amer pf. | N.Y.Curb | 102 | 101⅞ | 101⅞ | De.15, Ja.15 | Q 0.50 |
| Vanadium Corp | New York | ... | ... | 40⅜ | Fe.1, Fe.15, | Q 0.75 |
| Patino M. & E | N. Y. Curb | ... | ... | 25 | Nov. 5, 1926 | 5 sh. |
| **ASBESTOS** | | | | | | |
| Asbestos Corp | Montreal | 24 | 23⅜ | 23⅜ | Jan., 1926 | 1.50 |
| Asbestos Corp., pfd. | Montreal | 87 | 84 | 86 | De.31, Ja.15, | Q 1.75 |
| **SULPHUR** | | | | | | |
| Freeport Texas | New York | 43 | 41½ | 41⅜ | Ja.15, Fe.1 | Q 0.50 |
| Texas Gulf, new | New York | 54 | 52½ | 53½ | De.1, De.15, | Q 1.00 |
| **MINING, SMELTING, REFINING AND GENERAL** | | | | | | |
| Amer. Metal | New York | 42⅛ | 42 | 42½ | Fe.18, Ma. 1, | Q 0.75 |
| Amer. Metal pfd | New York | .... | .... | 109⅛ | Fe.19, Ma.1 | Q 1.75 |
| Amer. Sm. & Ref | New York | 143⅜ | 138 | 139⅞ | Ja.14, Fe.1, | Q 2.00 |
| Amer. Sm.&Ref.pfd. | New York | 122 | 121½ | 121½ | Fe.4, Ma.1, | Q 1.75 |
| Consol. M. & S | Montreal † | 2.51 | 2.49 | 2.50 | De.31, Ja.15 | X 6.25 |
| Federated Metals | N. Y. Curb | 13⅜ | 13⅜ | 13⅜ | ... | ... |
| Newmont Mining | N. Y. Curb | 69 | 68⅜ | 69 | De.31, Ja.17, | 0.60 |
| U. S. Sm. R. & M. | New York | 35⅞ | 34⅜ | 35⅛ | Ja.6, Ja.15, | Q 0.87½ |
| U. S. Sm. R.&M.pfd. | New York | 46⅛ | 46 | 46⅜ | Ja.6, Ja.15, | Q 0.87½ |

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Indicates extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur F. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

## LONDON QUOTATIONS—WEEK ENDED JAN. 25, 1927

| Name | High | Low | Last | Last Div. Date | Amount |
|---|---|---|---|---|---|
| Aramayo Mines (25 frs.) | 81/— | 78/9 | 78/9 | Feb. 1927 | 5 p.c.† |
| British Platinum (£1) | 3/3 | 2/4½ | 3/— | Feb. 1925 | 2½ p.c. |
| Burma Corpn. (10 rupees) | 14/9 | 13/10½ | 14/— | Feb. 1927 | 6 annas* |
| Bwana M'Kubwa (5s) | 6/9 | 6/3 | 6/6 | ... | ... |
| Camp Bird (2s) | 4/1½ | 2/7½ | 2/9 | ... | ... |
| El Oro (£1) | 5/— | 4/7½ | 4/10½ | Nov. 1924 | 2½ p.c.* |
| Esperanza (10s) | —/4½ | —/3 | —/3 | ... | ... |
| Frontino & Bolivia (£1) | 13/1½ | 11/6 | 11/6 | Jan. 1927 | 5 p.c. |
| Mexican Corpn. (£1) | 9/6 | 9/1½ | 9/6 | ... | ... |
| Mexico Mines of El Oro (£1) | 17/6 | 15/7½ | 17/6 | Dec. 1926 | 3½ p.c.* |
| N'Changa Copper Mining | 18/6 | 16/10½ | 17/6 | ... | ... |
| Oroville Dredging (£1) | 5/1½ | 4/9 | 5/— | Dec. 1923 | 3½ p.c. |
| Ouro Preto (£1) | 2/1½ | 2/— | 2/— | May 1925 | 2½ p.c. |
| Rhodesian Congo Border (£1) | 83/1½ | 80/— | 80/— | ... | ... |
| St. John del Rey (£1) | 10/1½ | 9/7½ | 9/9 | June 1925 | 6½ p.c. |
| San Francisco Mines (10s) | 29/6 | 28/7½ | 29/3 | Jan. 1927 | 25s. |
| Santa Gertrudis (£1) | 15/3 | 14/7½ | 14/9 | Jan. 1927 | 3½ p.c. |
| Selukwe (2s. 6d.) | 11/6 | 10/— | 10/— | April 1917 | 6½ p.c. |
| S. Amer. Copper (2s.) | 3/4½ | 3/— | 3/3 | Nov. 1917 | 75 p.c. |
| Tanganyika (£1) | 52/3 | 43/6 | 47/6 | Aug. 1926 | 7½ p.c. |
| Tomboy (£1) | 3/1½ | 3/— | 3/— | July 1926 | 10 p.c. |
| Union Miniere du Haut-Katanga (Brussels) | 9.200 | 8.500 | 9.000 | July 1926 | 175 (‡) |

* Free of British income tax. † Swiss frs. ‡ Belgian frs. and free of taxation